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SURVEY OF TRUCK AND BUS OPERATING MODES IN EACH OF EIGHT CITIES

J. D. McCullough, et al

Ethyl Corporation

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SURVEY OF TRUCK AND BUS OPERATING MODES IN EACH OF EIGHT CITIES

for

Division of Air Pollution
U. S. Public Health Service

Project No. 90602
Contract No. PH 86-62-12

Quarterly Progress Report No. 2
Period Ending March 1, 1962

Principal Investigators

J. D. McCullough
George Robinson
G. W. Thomson
Cleveland Walcutt

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Ethyl Corporation Research Laboratories, Detroit, Michigan

TABLE OF CONTENTS

OBJECTIVE 1

MEANS OF ACHIEVING OBJECTIVE 1

SCOPE OF REPORT 1

SUMMARY 1

PERSONNEL 3

PROGRESS DETAILS

Vehicle Instrumentation . . . . . A

Computer Programming . . . . . B

Vehicle Selection C

Vehicle Procurement . . . . . D

Data Procurement . . . . . E

OBJECTIVE

To determine the group or groups of operating modes which satisfactorily describe the actual operation of trucks and buses in each of eight U. S. cities.

MEANS OF ACHIEVING OBJECTIVE

1. Design and build six automatic punch-tape instruments to measure engine speed and manifold vacuum (load criteria for diesel engines) at one-second intervals throughout the normal operating day of a vehicle on the road.

2. Program a 1620 IBM computer to receive the punch-tape data and summarize the performance of each vehicle in 97 different selected subcategories.

3. Select and procure approximately 100 vehicles in each of eight cities, properly weighted with respect to exhaust emission, which best represent the operation of all vehicles in a city.

4. Equip the selected vehicles with recording instrumentation and obtain data on vehicle performance.

5. Process recorded data in a suitably programmed 1620 IBM computer.

6. Reduce the processed data to fit the objective.

SCOPE OF REPORT

During the second quarterly period, effort was concentrated on vehicle instrumentation, computer programming, vehicle selection, vehicle procurement, and data procurement.

SUMMARY

Preparations for a survey of the operating modes of trucks and buses in each of eight cities are proceeding simultaneously in four areas -- vehicle instrumentation, computer programming, vehicle selection, and vehicle procurement. In addition, work has been started on data procurement.

Vehicle Instrumentation

The first prototype instrument has been completely built and debugged after about 400 hours of laboratory and vehicular testing. The instrument has worked, unattended, on commercial vehicles for periods up to 8 hours. During this time, information concerning engine speed and manifold vacuum was punched out on a paper tape at one-second intervals. Direct read-out of this punched data into an IBM 1620 computer has been performed.

The instrument has the capability to measure engine speed with an accuracy within ± 1/2% and manifold vacuum within ± 1%. Tests have been conducted in a number of commercial vehicles, in which each unit was operated approximately 24,000 seconds (about 7 hours). Incorrect information was punched during 20 to 30 of the one-second intervals in which data were recorded. Approximately 1/3 of this misinformation occurred when the ignition key was turned off, then on again. Based on these figures, the computer would be expected to reject about 0.1% of the data punched on the tape record.

Two additional instruments should be completed by the middle of March. The other three instruments are about 30% completed.

Computer Programming

The computer program criteria, which had originally been thought to be adequate, were found unsatisfactory when punched-tape data from the first prototype instrument became available. This entailed a large number of changes in the IBM 1620 digital computer program for sub-categorizing engine-speed data. These changes were necessary to handle properly the slow, continuous accelerations and decelerations ("creeping" speed changes) which were being analyzed as constant-speed categories.

A number of other changes were needed in view of the new definitions of the manifold vacuum codes requested by California's Department of Public Health.

The complex logic of the new program was worked out and thoroughly debugged, using the ACT III compiler on the LGP-30 computer. Since it was found to handle satisfactorily all types of categories of vehicle opera-

tion, the program was transcribed into Format FORTRAN language and found to run successfully on the IBM 1620. However, the data-handling time was found to be excessive, so the program is being rewritten in machine language.

Vehicle Selection

A weighted sample, based on exhaust emission, of the trucks and buses registered over the past 14 years in each of the eight cities to be surveyed has been completed. The sample size was arbitrarily set at 100 vehicles per city. It may be advisable, as data are collected, to adjust the size of sample for the purpose of obtaining an adequate cross-section of the units operating in any one city. If so, the statistical tables presented would still be valuable, since the distribution of vehicles in different categories of make, year model, and weight classification would be unaffected.

Vehicle Procurement

Contacts through the mail with regional branches of the American Trucking Association indicate that about 4 to 5% of their members are willing to cooperate with us on the survey. We believe this will supply us with about 50% of the trucks needed.

We find that many truck operators who did not show willingness to cooperate via correspondence will do so when personally contacted. No trouble is anticipated in obtaining the required additional trucks.

Data Procurement

Engine-speed and manifold-vacuum test data recorded at one-second intervals have been obtained on a number of commercial vehicles in the Detroit area. Some of these preliminary tests indicated areas where instrument modifications were necessary. Satisfactory data procurement was obtained, with only about 0.1% being incorrectly recorded.

PERSONNEL

Ethyl Corporation employees who worked on Public Health Service Contract No. PH 86-62-12 during the second one-quarter period from December 1, 1961 to March 1, 1962 are:

Aiken, R.	Engrg. Technician
Alsterberg, C.	Engineer
Bastianelli, J.	Toolmaker
Bruce, D.	Welder
Guthrie, D. L.	Instrument Technician
Immethun, P.	Chem. Technician
Johnson, R. W.	Toolmaker
Koelsch, J.	Computer Programmer
Lajiness, E.	Chemist
McCullough, J. D.	Asst. Supv. - Instrumentation
Malone, V.	Foreman - Exp. Auto Mechanic
Mosey, N.	Instrument Technician
Peterson, A.	Photographic Technician
Poehlman, C.	Engineer
Robinson, G. S.	Supv. - Fleet Test
Rometti, M.	Supv. - Machine Shop
Stolz, H.	Toolmaker
Thomson, G. W.	Sr. Res. Associate
Walcutt, C.	Sr. Res. Associate
Wanderer, W.	Engineer
Zawadski, J.	Toolmaker
Zelda, E.	Engineer

SECTION A

TABLE OF CONTENTS

SUMMARY A-1

PROBLEM AREAS. A-1

Relays A-1
Vehicle Generator Voltage A-3
Parity Checks. A-3
Vacuum Transducer A-3

INSTRUMENT PERFORMANCE. A-4

CURRENT STATUS A-4

SECTION A

VEHICLE INSTRUMENTATION

SUMMARY

The basic instrument design has provided engine-speed and manifold-vacuum data from commercial trucks in a form suitable for processing on the IBM 1620 computer.

Experience in vehicles uncovered some minor unforeseen difficulties. However, the instrumentation has been modified to improve reliability and accuracy, and it now seems probable that the instruments will provide digital data accurate within ± 1/2% for engine speed and ± 1% for manifold vacuum, over ambient temperatures ranging from 120°F to 10°F. In addition, instrument maintenance is not expected to pose any major problems.

To reach this level of confidence we have had to surmount a number of development problems. The present status of instrument construction is shown in the following table.

Instrument No.	% Completed	Notes
1	100	Approx. 400 hrs operation
2	100	In engineering testing
3	100	Ready for testing
4	30	Mechanical Construction Phase
5	25	Mechanical Construction Phase
6	20	Mechanical Construction Phase

PROBLEM AREAS

1. Relays - The major development problem arose from use of a recent technological development as one of the key components of the instrument package. In order to make the over-all package as small as practical, yet accumulate the data in one-second interval, some 28 high-speed magnetic-reed relays were used in the programming and encoding circuits. Samples of these relays, obtained from Struthers-Dunn Inc., Pitman, New Jersey, seemed just the answer to our needs. However, as test hours accumulated

on individual circuit breadboards, it became apparent that performance of individual relays varied widely from the samples supplied.

The poor performance of the magnetic-reed relays, coupled with Struthers-Dunn's failure to meet delivery schedules, delayed completion of the prototype instrument by at least 30 days. By early December, it became painfully clear that an alternate supplier would be required. Unfortunately, Struthers-Dunn appeared to be the only commercial supplier of miniaturized, multiple-pole, millisecond-response, reed relays. These devices were a very recent development, and competition had not yet appeared.

Knowing that there were several suppliers of evacuated reed switches (the starting point for the magnetic reed relays), we obtained sample lots of those switches, plus a test coil used to inspect production runs of them. The reed switch is normally actuated by a permanent bar magnet. By supplying a known current to the test coil, the manufacturer can determine the magnetomotive force necessary to actuate the switch.

By suitably potting a sample reed switch in a test coil with epoxy resin, we assembled a homemade magnetic-reed relay. Its performance was so superior to that of the Struthers-Dunn relays that we immediately contacted the switch manufacturer (Hamlin, Inc.). These people were most cooperative, suggesting that we contact the firm supplying their test coils, and offering all possible assistance. Thus, Wabash Magnetics Inc. agreed to make special coils for us and to pot the Hamlin reed switches (developed in the fall of 1961) in epoxy resin to meet our needs. Through extremely cooperative efforts, Wabash Magnetics supplied all our needs within two and one-half weeks. The performance of these units has been excellent.

As soon as reliable reed-relays had been acquired, the prototype instrument was completed and subjected to a wide variety of bench tests. The prototype successfully passed performance

tests for speed of response, accuracy, temperature extremes, humidity and variations in supply voltage. Emphasis was then shifted to "on the road" testing.

2. Vehicle Generator Voltage - Preliminary testing of the prototype instrument on company vehicles and on Detroit Edison fleet trucks uncovered one major design limitation. Initial design goals had visualized operation on a 12-volt electrical system. Consequently, circuits were designed to work satisfactorily from 10.5 volts to 14.5 volts, in order to cover possible battery terminal voltage changes during the charge-discharge cycle. This design goal proved to be unrealistic. In cold weather, battery terminal voltages in excess of 16 volts were observed on one Detroit Edison fleet truck. While this truck proved to have the highest terminal voltage of many trucks surveyed, it still represented a potential field problem.

Minor modifications to the tape-punch motor and to the circuitry were made to insure satisfactory operation from 10.5 volts to 17 volts (12.6 volts nominal; + 36%, - 15%). Further modifications are necessary for operation on 6-volt systems.

3. Parity Checks - Vehicle testing also indicated occasional malfunction in the parity-check relay circuits. These difficulties were cured by rearranging the punch-magnet control relay circuits in the tape punch and adding diode-type transient-voltage suppressors on all punch circuits.

4. Vacuum Transducer - The vacuum transducer was originally fabricated with a stainless steel actuating shaft which transferred diaphragm motion to a 30-point selector switch. To reduce static friction, a linear recirculating-ball bearing guided the stainless steel shaft. As test hours accumulated, it was apparent that stainless steel was too soft to support the unit loads at ball contact surfaces. Consequently, all transducer shafts were replaced with hardened and ground steel shafts. Immediately after all the preceding changes had been incorporated into the instrument package,

acceptable data from field tests were obtained.

INSTRUMENT PERFORMANCE

A typical 8-hour test run shows 24,000 seconds of operation involving 96,000 individual data or instructional punch cycles. Of these 96,000 punches, some 15 to 30 punches would be rejected by the IBM 1620 computer as improperly coded or punched. We believe that this is an acceptable level of performance for this type of digital equipment.

Of the above 15 to 30 unacceptable punches, some rejections are due to the driver's stopping and restarting his engine at delivery points. When the ignition key is turned off, any data in process is interrupted but remains mechanically coded in the punch. The next time the punch starts up, it begins a new one-second record interval, thus including some data from the last second of operation just prior to the "ignition off" state. Thus, the tape may show a vacuum-vacuum-tens-units-instruction code sequence, which contains a superfluous vacuum record. The computer automatically rejects these data and proceeds to the next one-second record. Experience to date indicates that the percentages of such incidents are so low as to be negligible.

CURRENT STATUS

As indicated in the summary at the beginning of this section, three instruments have been fabricated. Two of these instruments have yet to pass bench and road acceptance tests. The remaining three instruments are in production and should progress rapidly.

Figures 1 to 8 are photographs of the instrument package in various stages of development and assembly.

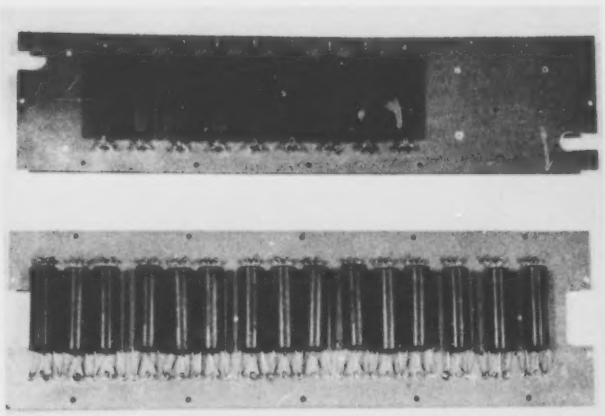


Figure 1

Rear View of Relay Modules

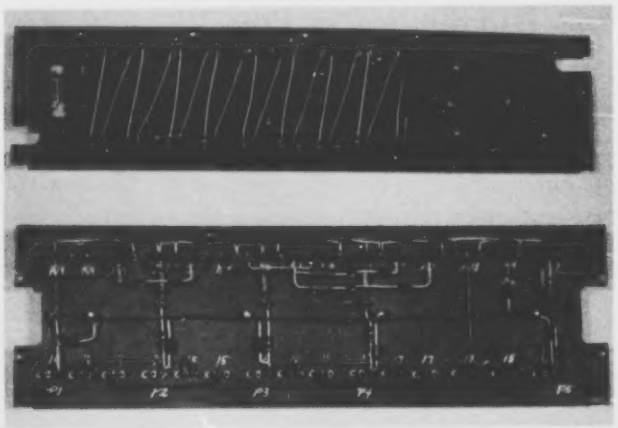


Figure 2

Front View of Relay Modules

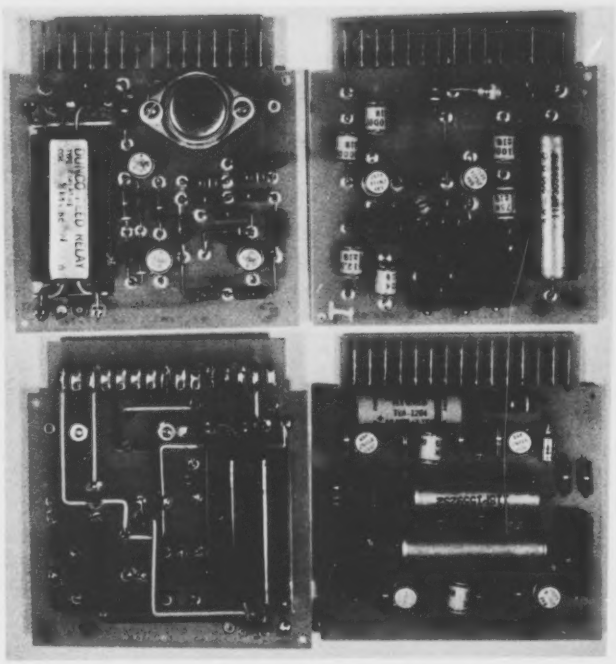


Figure 3

Typical Purchased Plug-in Circuits

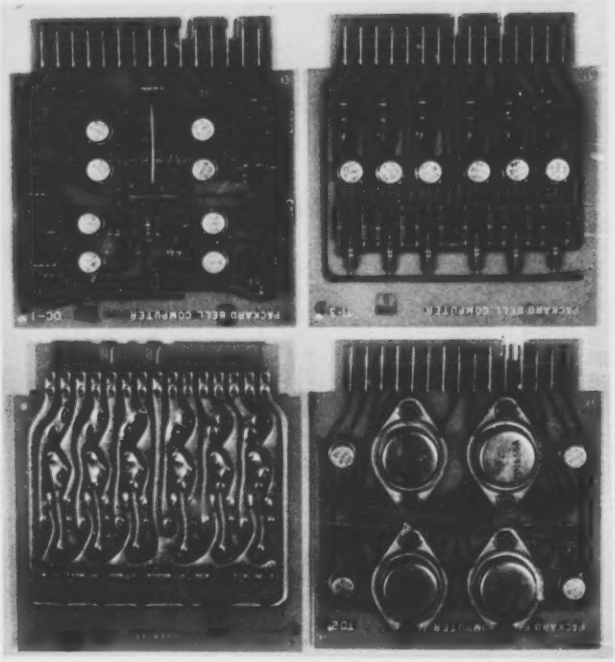


Figure 4

Typical Custom-Wired Plug-in Circuits

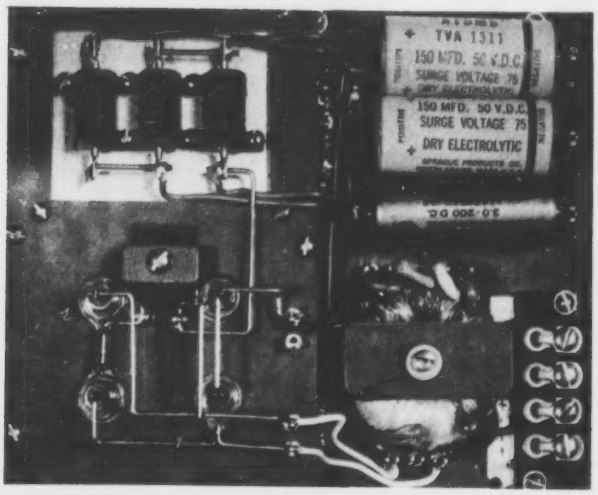


Figure 5

Instrument Power Supply

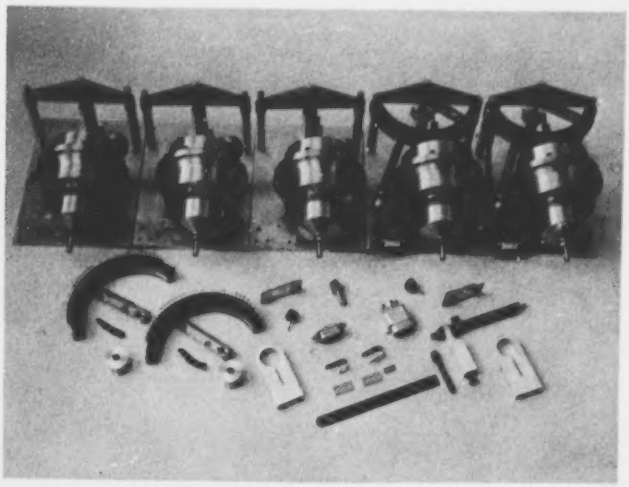


Figure 6

Stages of Assembly--Vacuum Transducers

Figure 7

Punch-Tape Assembly
with Modifying Parts

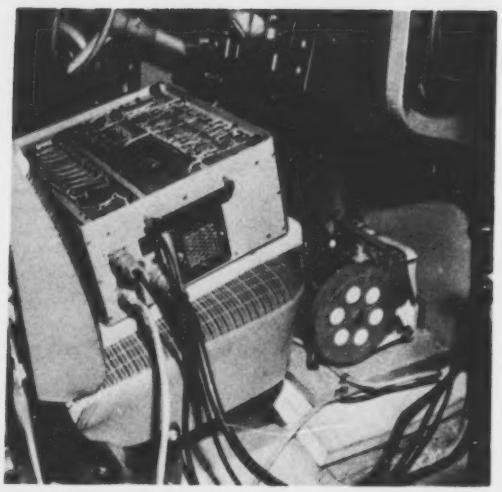


Figure 8

Prototype Instrument
Installed (Covers Removed)

SECTION B

COMPUTER PROGRAMMING

SUMMARY

The computer program criteria, which had originally been thought to be adequate, were found unsatisfactory when punched-tape data from the first prototype instrument became available. This entailed a large number of changes in the IBM 1620 digital computer program for subcategorizing engine-speed data. These changes were necessary to handle properly the slow, continuous accelerations and decelerations ("creeping" speed changes) which were being analyzed as constant-speed categories.

A number of other changes were needed in view of the new definitions of the manifold vacuum codes requested by California's Department of Public Health.

The complex logic of the new program was worked out and thoroughly debugged, using the ACT III compiler on the LGP-30 computer. Since it was found to handle satisfactorily all types of categories of vehicle operation, the program was transcribed into Format FORTRAN language and found to run successfully on the IBM 1620. However, the data-handling time was found to be excessive, so the program is being rewritten in machine language.

INTRODUCTION

As mentioned, a large number of changes were required in the IBM 1620 digital computer program for subcategorizing the engine speed and manifold vacuum data. These changes were necessary in order to properly analyze slow accelerations and decelerations, which were found to occur frequently in test runs. A number of other changes were needed to comply with the new definitions of the manifold vacuum codes and to incorporate the special input subroutine which was promised in October 1961 and finally received in working order from IBM on February 22, 1962. In order to avoid confusion, some of the information in the preceding report (QPR-1) has been repeated.

The complex logic of the new program was worked out and thoroughly debugged using the ACT III compiler on the LGP-30 computer. In addition, 21 examples were worked out, using the test sets of data discussed in QPR-1 with three different values of the idle manifold vacuum (IVAC = 5, 6, 7) and three more for a special 70-point synthetic set of data designed to test the logic of handling the "creeping" categories. This program (PHS-30-6) was then transcribed into Format FORTRAN language (PHS-1620-6) and compiled with the IBM 1620. Since ACT III is a second-generation FORTRAN-type compiler, translation to IBM 1620 Format FORTRAN language was straightforward. However, a memory overlap of 1,247 locations resulted. Two refinements led to Program PHS-1620-8, with 1,600 fewer storage locations. The remaining 353 open locations do not permit more than minor additions. This program is discussed in detail in this quarterly report.

Shortly after the new input subroutine was received, Program PHS-1620-2A, which was closely similar to the one shown in QPR-1, was compiled and timed. The time to process each data point (corresponding to each second of vehicle operation) was 0.25 second. This was only a little shorter than the LGP-30 machine language processing time of 0.38 second, using the similar program, PHS-30-2. A test indicated that tape input time on the IBM 1620 was not the limiting factor. Thus, the unexpectedly long time must be due to the number of FORTRAN machine language instructions needed per source language statement. A rough calculation showed that a several-fold saving in processing time could be made by reprogramming Program PHS-1620-8 in machine language. This is now being done.

CODING OF ENGINE SPEED AND MANIFOLD VACUUM

Engine speeds are coded, as before, as two-digit integers 00 to 99, equal to the engine speed in rpm divided by 40. The manifold-vacuum pressure is coded as a single digit 1 to 9, which is punched before the two digits for the engine speed. These three digits, designated MVTU in the computer program, followed by a special symbol termed a "record mark,"

are punched on paper tape every second. They comprise the input to the computer. The manifold vacuum coding has been changed to give more information on the lower range:

Manifold Vacuum, inches	Code V
0 to < 2	1
2 to < 4	2
4 to < 6	3
6 to < 15	4
15 to < 17	5
17 to < 19	6
19 to < 21	7
21 to < 24	8
⩾ 24	9

VALID DATA POINTS

A special data-input subroutine, designated KDT (1.), was written for us by IBM and added to the regular IBM 1620 Format FORTRAN system. It is described in detail in a later section.

A valid data point comprises three punched digits -- V, T, U -- between two record marks, such that V = 1 to 9, T = 0 to 9, U = 0 to 9. The special ender has V = 0, T = 0, U = 0.

If the punchout between two record marks consists of digits (D) in any of the following forms:

D
DD
DDDD
DDDDD, etc.

then this punchout is rejected as a nonvalid data point within the special data input subroutine KDT (1.). The subroutine does not store or count this value, but returns to its start to read the next data point from the tape.

If the punchout between two record marks consists of three digits with one or two leading zeros (but not three zeros), the data point is accepted by the KDT (1.) subroutine, but is rejected by subsequent tests in

our computer program. Three zeros, which is accepted by the KDT (1.) subroutine, is used as a data ender as previously noted.

In brief, input data points are considered valid and are stored as MVTU if the three digits lie in the range 100 to 999. Nonvalid data points are ignored, using the convention that the sequence of valid data points occurs with one-second intervals between the valid data points.

J, K, L, M NOTATION FOR ENGINE SPEED AND MANIFOLD VACUUM

For convenience, the prefixes J, K, L, and M are used as shown for engine speeds and for some other quantities:

MSPD	Coded engine speed at any given second
LSPD	Coded engine speed one second before MSPD
KSPD	Coded speed two seconds before MSPD
JSPD	Coded speed three seconds before MSPD
MVAC	Coded manifold vacuum at the same given second as MSPD
LVAC	Coded manifold vacuum one second before MVAC

CURRENT CATEGORY, MCAT

The "current category" MCAT is based broadly on conditions during the preceding second of vehicle operation, but in some cases it is necessary to consider other quantities, as described in detail below. When MCAT has been established, the corresponding storage is loaded as shown below. For convenience, the applicable range of MVAC is also shown.

	Symbol	MCAT	MVAC Range
idle	IDL	0	near IVAC
cruise	CRU	1	4 to 9
full-throttle constant-speed	FTC	2	1 to 3
part-throttle acceleration	PTA	3	4 to 9
full-throttle acceleration	FTA	4	1 to 3
mild deceleration	MDE	5	1 to 8
heavy deceleration	HDE	6	9

In the computer analysis, the corresponding slow or "creeping" accelerations and decelerations are given codes equal to the complements of the values above, i.e., -3, -4, -5, and -6. These temporary designations are later changed to the corresponding positive numbers and used like the standard codes above.

These seven categories are subdivided into 97 subcategories, depending on the initial and final speed range involved. This has been fully described in QPR-1, pages B-2, B-3, B-5, and B-6.

LAST CATEGORY, LCAT

The term "last category," LCAT, is used in the basic comparison with MCAT, the current category based on the preceding second of engine operation. As soon as a category changes, i.e., as soon as MCAT is no longer equal to LCAT, MCAT becomes the new LCAT and serves as the new reference basis until the category changes again. In other words, LCAT is based on the first second of operation in the new category.

GENERAL PLAN OF THE COMPUTER PROGRAM

In general, the plan of the computer program is essentially the same as before. It is in three parts: the categorizing loop, the subcategorizing loop, and the printout program. In brief, as each data point is entered, it is analyzed to determine the current category (MCAT). If this is the same as LCAT, the last category (i.e., the current category during the second when the category was first entered), a temporary duration register (KDUR) is incremented by one second and we return for a new point. As soon as the current category differs from the last category, the subcategorizing loop is entered and the subcategory index (I) is computed. The contents of the temporary duration register are added to the subcategory duration storage, and the subcategory incidence storage is incremented by one. The temporary duration register is made zero, the last category is made equal to the current category, and we return for the input of a new point. On the entry of a zero, the last point calculations are concluded and the printout begins. There are a number of storages which must be set, changed, or incremented in order to make the program operational. The details are shown on the flow plans.

The new definitions of the categories and their relation to the new computer program are shown in the following sections.

IDLE CATEGORY

The vehicle is said to be in the "idle" category if the engine speed (MSPD) is low and the current manifold vacuum (MVAC) is equal to or near the manifold vacuum under idle conditions (IVAC). In coded units, "idle" corresponds to MSPD < 17, i.e., engine speed below 680 rpm,

and if IVAC = 5, MVAC = 5 or 6

or if IVAC = 6, MVAC = 5, 6, or 7

or if IVAC = 7, MVAC = 6 or 7

When these conditions obtain, MCAT, the current category value, is set equal to zero.

NON-IDLE CATEGORIES

In our previous work, if the category is not "idle," the criteria for cruise or constant speed, acceleration, or deceleration were defined by:

	MSPD - LSPD	
Category	Coded	rpm
Deceleration	-2 or lower	-80 or lower
Cruise or constant speed	-1, 0, +1	-40, 0, +40
Acceleration	+2 or higher	+80 or higher

The distinction between part and full-throttle acceleration, between mild and heavy deceleration, and between cruise and full-throttle constant speed depends on the vacuum at the moment, as noted in the MCAT definitions.

At the time when the original computer program was conceived and written, it was arbitrarily decided that a change in coded speed less than 2 (80 rpm) was a constant-speed category. It was unknown at the time that a creeping acceleration or deceleration with MSPD - LSPD within the -1, 0, +1 range would occur for an appreciable length of time. However, examination of actual data tapes from vehicles using the prototype instrumentation showed that creeping accelerations or decelerations of relatively long duration were an important feature. The computer program

has now been revised, using new criteria to distinguish in the "non-idle" categories between a constant and a creeping speed operation.

It was necessary to use criteria other than MSPD - LSPD alone. The least ambiguous criteria include MSPD - JSPD, where JSPD is the coded engine speed three seconds before MSPD. The criteria are summarized in the following table and are implemented in the computer program shown in the flow plan. The main features of the earlier criteria mentioned above have been retained so that clear-cut cases of the seven categories are analyzed as before.

Criteria for Categorizing[a]				
MSPD-LSPD	LCAT[b]	MSPD-JSPD	KDUR	MCAT[b]
-3	-	-	-	Dec.
+3	-	-	-	Acc.
-2	Dec.	-	-	Dec.
-2	Cr. Dec.	-	-	Cr. Dec.
+2	Acc.	-	-	Acc.
+2	Cr. Acc.	-	-	Cr. Acc.
-2, -1, 0, +1	Acc.	-	-	Cru.
-1, 0, +1, +2	Dec.	-	-	Cru.
-2, -1, 0, +1, +2	Idle	-	-	Cru.
-1, 0, +1, +2	Cr. Dec.	$\leqslant -2$	-	Cr. Dec.
-1, 0, +1, +2	Cr. Dec.	$\geqslant -1$	-	Cru.
-2, -1, 0, +1	Cr. Acc.	$\geqslant +2$	-	Cr. Acc.
-2, -1, 0, +1	Cr. Acc.	$\leqslant +1$	-	Cru.
-2, -1, 0, +1, +2	Cru.	-1, 0, +1	-	Cru.
-2, -1, 0, +1, +2	Cru.	$\leqslant -2$	$\geqslant 3$	Cr. Dec.
-2, -1, 0, +1, +2	Cru.	$\leqslant -2$	1, 2	Cr. Dec.[c]
-2, -1, 0, +1, +2	Cru.	$\geqslant +2$	$\geqslant 3$	Cr. Acc.
-2, -1, 0, +1, +2	Cru.	$\geqslant +2$	1, 2	Cr. Acc.[c]

a. The criteria are used in this order: the first two columns together, then the third, then the fourth column.

b. Depending on the manifold vacuum (MVAC), Cru. means either CRU or FTC, Acc. means either PTA or FTA, Dec. means either MDE or

HDE, with Cr. their creeping counterparts.

c. There is a special recycle described in the text.

These criteria permit differentiation between the creeping categories and true cruise or constant speed conditions. Note that an occasional jump of 2 coded units is also allowed for in the creeping categories. If the last category (LCAT) was CRU (or FTC) and MSPD - JSPD exceeds 2, then a further test on the temporary duration counter (KDUR) is made. If KDUR is 3 seconds or more, MCAT is changed to show a creeping acceleration and the program goes to the subcategorizing loop, since MCAT is no longer equal to LCAT. However, if KDUR is small (less than 3 seconds), MCAT is changed as before but a special recycle is made which bypasses the subcategorizing loop, sets LCAT equal to MCAT, and does not zero the KDUR counter. In this way, the start of the creeping category is referred back to the beginning of the CRU category and unrealistic hopping in and out of categories is avoided. Similar devices are used to prevent incorrect categorizing when creeping categories are changed to true cruise conditions.

COMPUTER PROGRAM FLOW PLAN

The flow plan for Program PHS-1620-8 is in two parts. The main section shows a map of the whole program, but does not include the section on the determination of the subcategory index I from the values of LCAT, ISPD, and LSPD, since these steps are exactly the same as in the QPR-1 flow plan.

The determination of the current category (MCAT), using the new logical decisions, is shown in the other part of the flow plan. This includes some programming devices which had to be used in order to prevent the object program from overflowing the limited storage space of the IBM 1620. Most of these are self-evident, with the exception of the use of the K in statements 48, 49, and 50. It is necessary to branch six ways on the basis of LCAT, the six being: LCAT = -5 or -6, -3 or -4, 0, 1 or 2, 3 or 4, 5 or 6. This is done by the transformation:

$$K = 4.498 + 0.567\ LCAT$$

which truncates to the values below:

LCAT	K
-5 or -6	1
-3 or -4	2
--	3
0	4
1 or 2	5
3 or 4	6
5 or 6	7

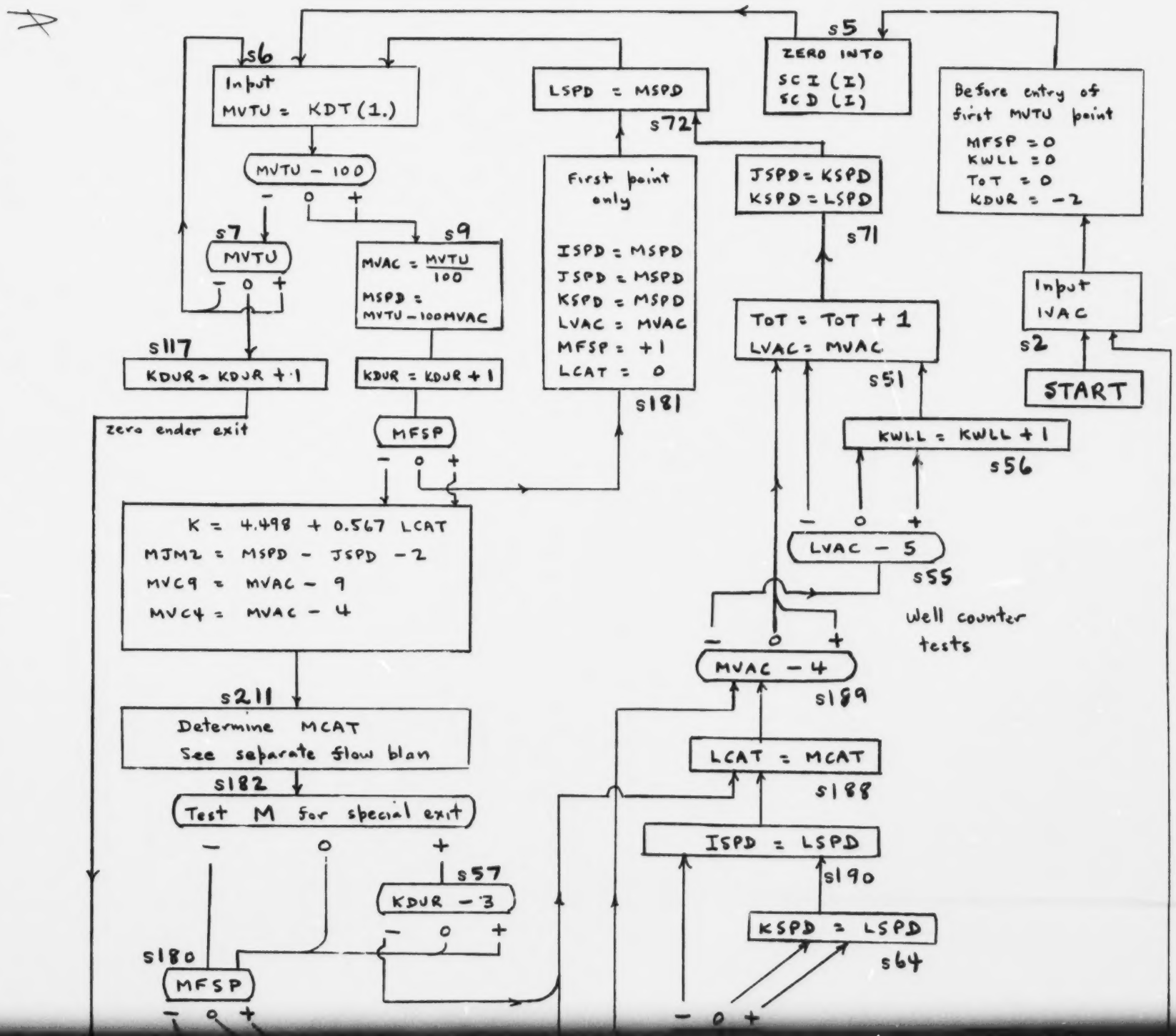
(K = 3 is a dummy branch since LCAT = -1 or -2 is not used.) It is estimated that several hundred locations of storage were saved by the use of "computed go to" statements based on K instead of the corresponding "if" statements.

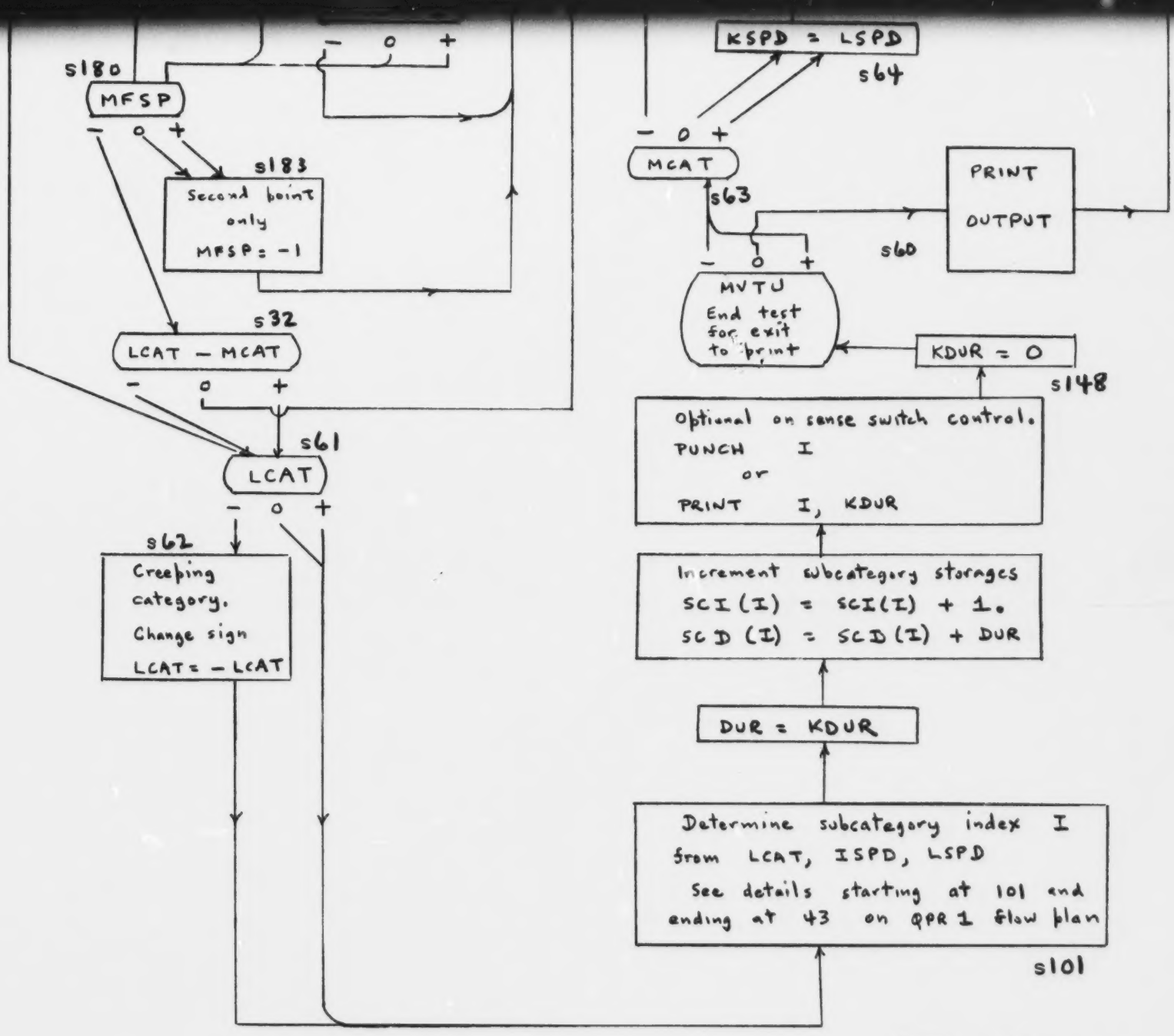
SPECIAL INPUT SUBROUTINE, KDT (1.)

A special input subroutine was needed to accept both valid data points (MVTU = 000 or 100 to 999) and improperly punched data without hangup. Accidental non-punching of the vacuum code at a particular second would give only the speed digits (say 63) between two adjacent record marks. If data input were right-justified, as on many other computers such as the LGP-30, the ordinary FORTRAN data input routine could have been used. This input would have been stored as MVTU = 63 and would have been rejected in the computer program. However, the IBM 1620 FORTRAN data input is left-justified to a specified field width, here equal to 3. The input would thus load as MVTU = 630 which would have been incorrectly accepted as a valid data point. The special KDT (1.) subroutine for the Format FORTRAN system, written for us by the local IBM staff, obviates these difficulties. Valid data points only are accepted, as has been noted in a preceding section. The subroutine is shown on the following page:

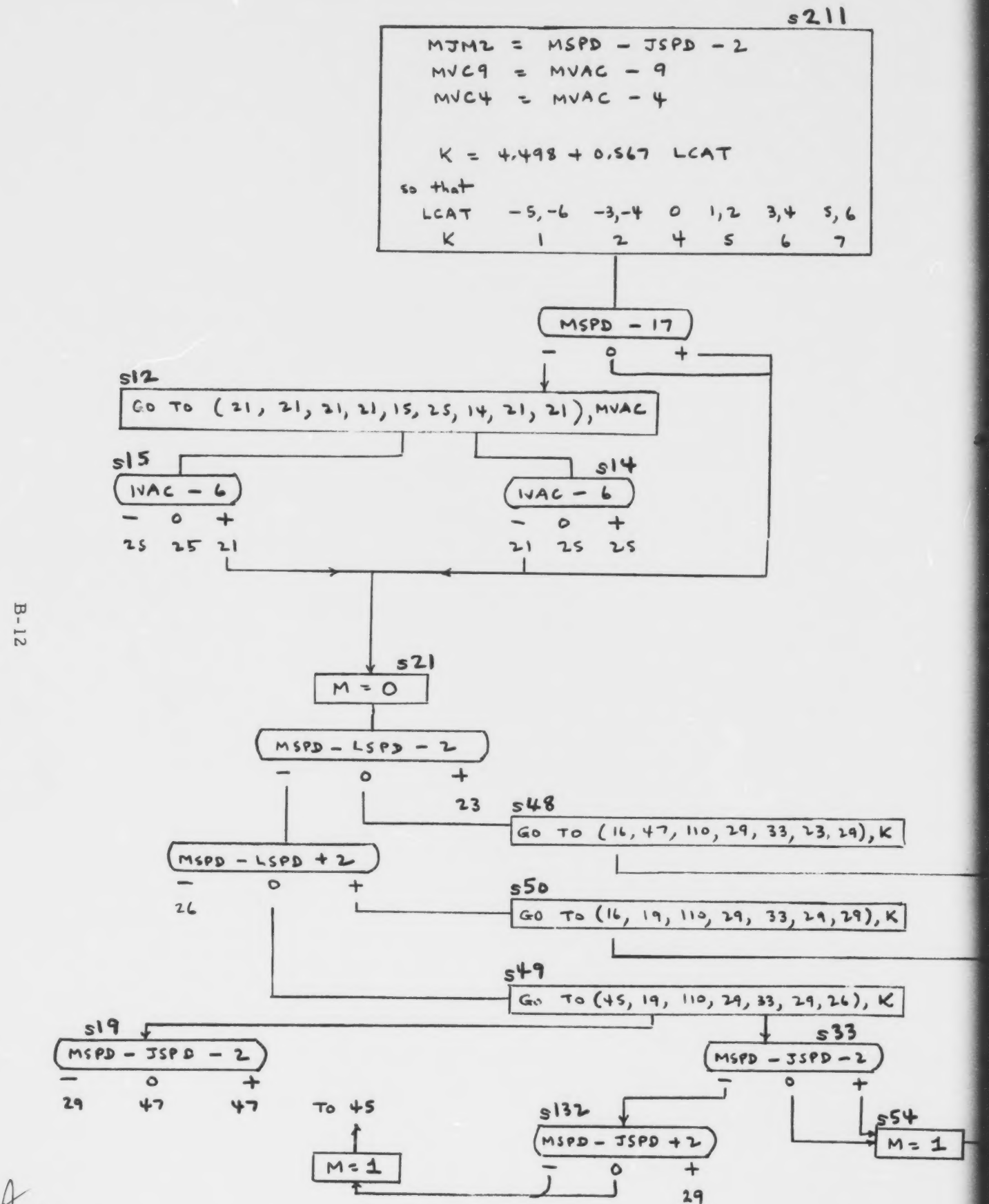
```
        DORG    5000
KDT     TFM     PLACE +4, 0
        RNPT    PLACE
        BNR     R1, PLACE +3
        TF      60, PLACE +2
        BB
R1      B       KDT
PLACE   DC      2, 0
        DS
        DEND
```

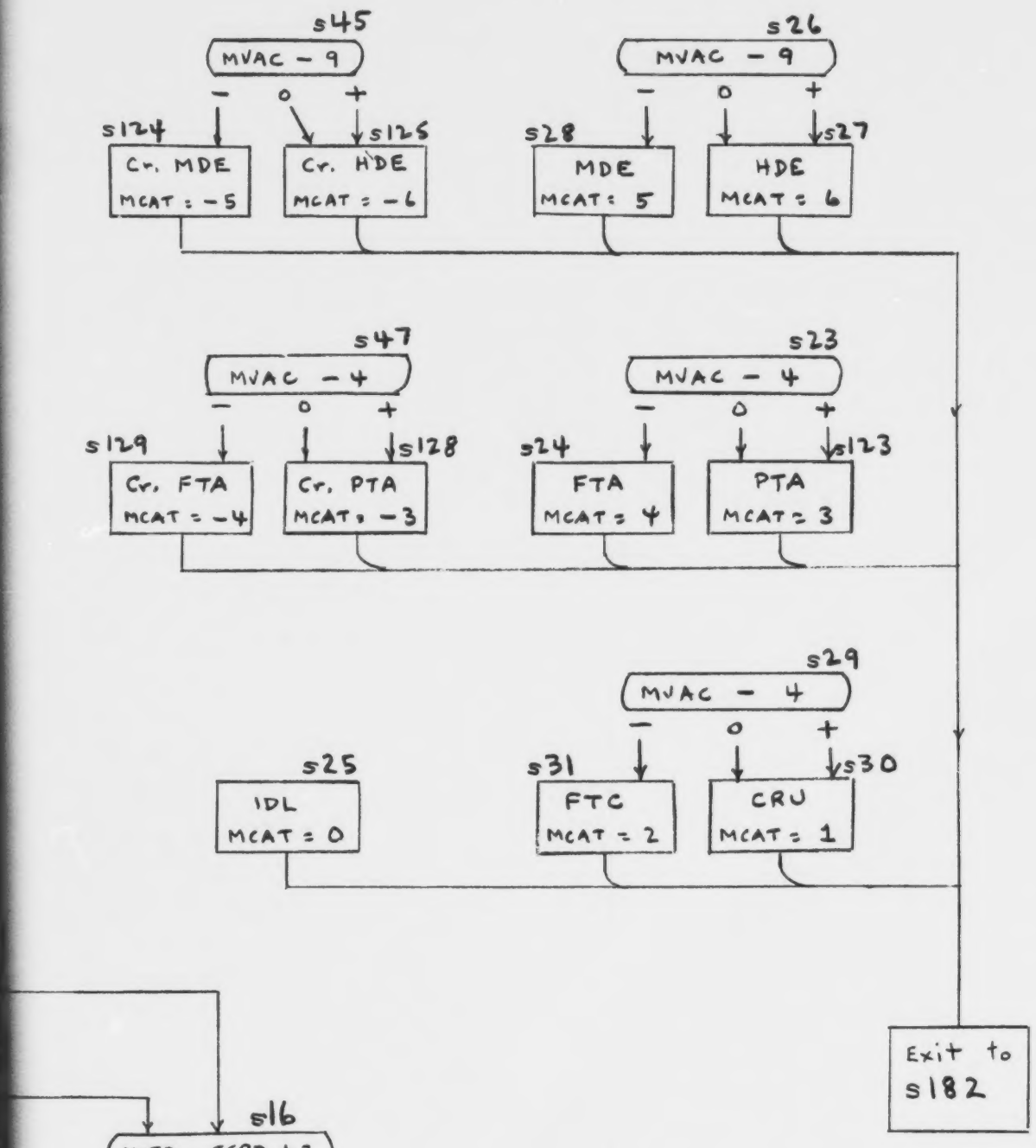
(This program is in IBM 1620 SPS language. Note that 60 is the absolute address of the FORTRAN accumulator.)


s6
Input
MVTU = KDT(1.)
MVTU - 100
- 0 +
s7
MVTU
- 0 +
s117
KDUR = KDUR + 1
zero ender exit
s9
MVAC = MVTU / 100
MSPD = MVTU - 100MVAC
KDUR = KDUR + 1
MFSP
- 0 +
K = 4.498 + 0.567 LCAT
MJM2 = MSPD - JSPD - 2
MVC9 = MVAC - 9
MVC4 = MVAC - 4
s211
Determine MCAT
See separate flow blan
s182
Test M for special exit
- 0 +
s57
KDUR - 3
- 0 +
s180
MFSP
- 0 +
LSPD = MSPD
s72
First point only
ISPD = MSPD
JSPD = MSPD
KSPD = MSPD
LVAC = MVAC
MFSP = +1
LCAT = 0
s181
s5
ZERO INTO
SCI (I)
SCD (I)
JSPD = KSPD
KSPD = LSPD
s71
TOT = TOT + 1
LVAC = MVAC
s51
KWLL = KWLL + 1
s56
- 0 +
LVAC - 5
s55
Well counter tests
- 0 +
MVAC - 4
s189
LCAT = MCAT
s188
ISPD = LSPD
s190
KSPD = LSPD
s64
- 0 +
Before entry of first MVTU point
MFSP = 0
KWLL = 0
TOT = 0
KDUR = -2
Input
IVAC
s2
START



ETHYL CORP.
DETROIT, MICH
PHS-1620-8


s211
MJM2 = MSPD - JSPD - 2
MVC9 = MVAC - 9
MVC4 = MVAC - 4
K = 4.498 + 0.567 LCAT
so that
LCAT -5,-6 -3,-4 0 1,2 3,4 5,6
K 1 2 4 5 6 7
MSPD - 17
- 0 +
s12
GO TO (21, 21, 21, 21, 15, 25, 14, 21, 21), MVAC
s15
IVAC - 6
- 0 +
25 25 21
s14
IVAC - 6
- 0 +
21 25 25
s21
M = 0
MSPD - LSPD - 2
- 0 +
23
s48
GO TO (16, 47, 110, 29, 33, 23, 29), K
MSPD - LSPD + 2
- 0 +
26
s50
GO TO (16, 19, 110, 29, 33, 29, 29), K
s49
GO TO (45, 19, 110, 29, 33, 29, 26), K
s19
MSPD - JSPD - 2
- 0 +
29 47 47
To 45
M = 1
s33
MSPD - JSPD - 2
- 0 +
s132
MSPD - JSPD + 2
- 0 +
29
s54
M = 1



Note:
The exit to 110 is a dummy since K = 3 is inadmissible

ETHYL CORP
DETROIT, MICH.
PHS – 1620 – 8

```
C       PHS SUBCATEGORIZING,  ETHYL,  PHS-1620-8,  3/7/62
DIMENSION SCI(97),SCD(97),SCP(97)
 187  FORMAT (F5.0)
1188  FORMAT (6HIVC = ,  I    2)
 388  FORMAT (I2)
 151  FORMAT (I3,  I8)
 166 FORMAT (9HWL CTR = ,I6)
 167  FORMAT (10HTOT SEC = ,F7.0)
 130  FORMAT (3HIDL)
 131  FORMAT (3HCRU)
1132  FORMAT (3HFTC)
 133  FORMAT (3HPTA)
 134  FORMAT (3HFTA)
 135  FORMAT (3HMDE)
 136 FORMAT (3HHDE)
 137 FORMAT (I7, I10, F11.0, F11.0, F11.2, F11.2)
 IF (SENSE SWITCH 1)  152, 2
 152  DO 153 I=1,97
 153  ACCEPT TAPE 187,SCP(I)
 2  ACCEPT 388, IVAC
 MFSP=0
 KWLL = 0
 TOT=0.
 KDUR = -2
 DO 5 I=1,97
 SCI(I) = 0.
 5  SCD(I) = 0.
 6  MVTU=KDT(1.)
 IF (MVTU - 100) 7, 9, 9
 7  IF(MVTU) 6,117, 6
 117  KDUR = KDUR + 1
 GO TO 61
     9 MVAC = MVTU/100
    10 MSPD =MVTU - 100*MVAC
     KDUR = KDUR + 1
 IF(MFSP) 211,181,211
 181  ISPD = MSPD
     JSPD = MSPD
     KSPD = MSPD
 LVAC = MVAC
 MFSP = 1
     LCAT = 0
     GO TO 72
 211 FLCT=LCAT
 K=4.498+.567*FLCT
 MJM2 = MSPD - JSPD -2
   MVC9=MVAC-9
   MVC4=MVAC-4
 IF (MSPD - 17) 12,21,21
 12  GO TO (21, 21, 21, 21, 15, 25, 14, 21, 21),  MVAC
 14   IF(IVAC - 6)21, 25, 25
 15  IF(IVAC-6)25,25,21
 21  M=0
 IF (MSPD - LSPD - 2) 74,48,23
```

```
74  IF (MSPD - LSPD +     2)  26, 49, 50
48  GO TO (16, 47, 110, 29, 33, 23, 29), K
49  GO TO (45, 19, 110, 29, 33, 29, 26), K
50  GO TO ( 16, 19, 110, 29, 33, 29, 29), K
19  IF(MJM2) 29, 47, 47
16  IF(MJM2 +4) 45, 45, 29
33  IF(MJM2) 132, 54, 54
132  IF (MJM2 +4)  52, 52, 29
45  IF(MVC9)124,125,125
124  MCAT = -5
GO TO 182
125   MCAT = -6
GO TO 182
47  IF(MVC4)129,128,128
128  MCAT = -3
GO TO 182
129  MCAT = -4
  GO TO 182
52  M = 1
GO TO 45
54  M = 1
GO TO 47
57  IF (KDUR - 3) 188, 180, 180
23  IF(MVC4)24,123,123
  123 MCAT = 3
GO TO 182
   24 MCAT = 4
GO TO 182
   25 MCAT =0
GO TO 182
26  IF(MVC9)28,27,27
   27 MCAT =6
GO TO 182
   28 MCAT = 5
GO TO 182
29  IF(MVC4)31,30,30
   30 MCAT =1
GO TO 182
31   MCAT = 2
182  IF (M) 180, 180, 57
180  IF (MFSP ) 32,183, 183
183  MFSP = -1
GO TO 188
32  IF (LCAT - MCAT) 61, 189, 61
61   IF (LCAT) 62, 101, 101
62   LCAT = - LCAT
GO TO 101
189  IF(MVC4)55,51,51
55   IF (LVAC - 5)  51, 56, 56
   56 KWLL = KWLL + 1
   51 LVAC = MVAC
      TOT = TOT + 1.
71   JSPD = KSPD
KSPD = LSPD
```

```
72  LSPD = MSPD
      GO TO 6
  101 IIS = ISPD/15+1
      IF(IIS - 6) 87,87,86
   86 IIS = 6
   87 IFS = LSPD/15+1
      IF(IFS-6) 102,102,89
   89 IFS = 6
  102 J=LCAT + 1
      GO TO (38,39,40,41,41,36,36),J
   38 I=1
      GO TO 44
   39 I=IFS + 1
      GO TO 44
   40 I=IFS+7
      GO TO 44
   36 I=(IIS - 1)*IIS/2 + IFS + 55
      IF(LCAT - 6) 44,43,43
   41 I=(IIS-1)*(12-IIS)/2+IFS+13
   42 IF(LCAT - 4) 44,43,43
   43 I=I+21
   44 ISPD = LSPD
DUR = KDUR
SCI(I) = SCI(I) + 1.
SCD(I) = SCD(I) + DUR
IF (SENSE SWITCH 2) 350, 248
350  PUNCH TAPE 388, I
248  IF (SENSE SWITCH 3)  150,148
150  PRINT 151, I, KDUR
148  KDUR = 0
IF (MVTU) 63, 60, 63
63   IF (MCAT) 190, 64, 64
64   KSPD = LSPD
190  ISPD = LSPD
188  LCAT = MCAT
GO TO 189
60   DO 171 I=1,97
65   FSCI = SCI(I)
FSCD=SCD(I)
IF (FSCD) 67, 171,  67
67   AVD = FSCD/FSCI +.005
PCT = FSCD*100./TOT +.005
FK  = SCP(I)
 J=FK/10000.
 NK=FK
 NI=NK/100
 KIS=100*NI
 KFS=(NK-KIS)*100
 GO TO (110,111,112,113,114,115,116),J
110 PRINT 130
GO TO 70
111 PRINT 131
GO TO 70
112 PRINT1132
```

```
GO TO 70
113 PRINT 133
GO TO 70
114 PRINT 134
GO TO 70
115 PRINT 135
GO TO 70
116 PRINT 136
70 PRINT 137, KIS, KFS, FSCI, FSCD, AVD, PCT
171 CONTINUE
  PRINT1188,  IVAC
PRINT 166,KWLL
PRINT 167, TOT
      GO TO 2
END
```

SECTION C

TABLE OF CONTENTS

SUMMARY C-1

STATEMENT OF PROBLEM C-1

DATA TABULATION C-2

SECTION C

VEHICLE SELECTION

SUMMARY

Except for changes which may be made later in the survey, vehicle selection in each of the eight cities is now completed. The field-test personnel will use the summary tables in this report as a guide to their selection of vehicles. However, because of lack of availability of vehicles and other unforeseen circumstances, rigorous adherence to the vehicle selection shown in the tables may not always be feasible. Deviation may be particularly necessary when endeavoring to obtain a vehicle of a certain kind having a specific use function.

An attempt will be made to obtain a uniform distribution in three use functions. These functions have been defined as fixed route (e.g., milk delivery), variable route (e.g., merchandise delivery), and no route (e.g., gravel and dirt hauling).

STATEMENT OF PROBLEM

A detailed description of the method of selection of vehicles in each city was presented in the progress report for the quarter ending December 1, 1961. Therefore, it will not be repeated in this report.

The objective in this selection is a random sampling of units which best represent the total population. As explained in the previous progress report, the factor of exhaust emission must be taken into consideration, although study of emission is not the primary objective of this survey.

The population of trucks and buses in each of the cities to be investigated was obtained from R. L. Polk and Company. They furnished us with vehicle registrations for the county containing the majority of each city's population. The vehicle registrations, as of July 1, 1960, for all year models back to 1948 were broken down into 11 makes -- Chevrolet, Diamond T, Divco, Dodge-Plymouth, Ford, GMC, International, Mack, Studebaker, White (including Autocar and Reo), and Willys. A miscellaneous group included Federal, Brockway, and Volkswagen. The number of vehicles of each make was further subdivided into year of manu-

facture or year model. The number of vehicles of each make and year model was finally divided into three gross-vehicle-weight (GVW) classifications -- light-weight (under 10,000 lbs.), medium-weight (10,000 to 19,500 lbs.), and heavy-weight (over 19,500 lbs.).

At the time the Polk data were requested, information as of July 1961 was not available. Therefore, the 1960 data were extrapolated for each vehicle make. It is believed that these estimated figures for 1961 models are reasonable.

The selection of vehicles for the five cities in this report, as well as the three cities in the previous report, is based on a sample of 100 vehicles per city. This number of units was selected because the contract requires a total of approximately 800 vehicles to be selected in eight different cities. Since some figure must be used for the analysis, a value of 100 appeared reasonable. It is realized, however, that after data have been obtained in one or two cities, analysis of the data may indicate the desirability of testing more or less units in each city. In such an event, the figures presented in this and the previous report will be useful as a basis for making a new selection.

DATA TABULATION

Tables C-1 to C-30 show vehicle registration, engine displacement, and the exhaust factor (see previous report for explanation) for vehicles in Chicago, Cincinnati, New Orleans, Philadelphia, and Washington, D. C. Each table lists -- for two vehicle makes, 14 model years, and 3 weight classifications -- the number of vehicles presently in existence (N_h), the cubic-inch displacement of their engines (C_h), and the product of these two items ($N_h C_h$).

Tables C-31 to C-35 summarize the analysis for the selection of vehicles in each of the cities. These tables show the computed values of n_h for each stratum embracing a specific combination of vehicle make, weight classification, and year model. The next to the last column contains the totals of n_h for the 14 model years of each make-weight classification. The last column shows the "rounded" figures which were arrived

at by the method explained in the progress report ending December 1, 1961. The value for $\sum_{1}^{504} N_h C_h$, the total emission factor for a city, is shown on each table.

The R. L. Polk registration data include all trucks and buses and makes no distinction between gasoline and diesel-powered vehicles. This is not expected to be any cause of difficulty in the selection of diesels, if included, since these units will be largely in the heavy classification only. It should be pointed out that the R. L. Polk information concerns the unloaded gross vehicle weight required for vehicle registration. This weight does not include the weight carried, or pulled in the case of tractor combinations. However, provision has been made to show the total loaded weight of each vehicle on the data sheet records.

Table C-1

Vehicle Registration, Engine Displacement, and Exhaust Factor

Chevrolet — Chicago

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	1,400	248	347,200	400	258	103,200	36	305	10,980
1960	1,314	248	325,870	386	258	99,590	36	305	10,980
1959	2,037	258	525,540	857	272	233,100			
1958	1,621	259	419,840	606	267	161,800			
1957	1,983	236	467,988	875	260	227,500			
1956	1,674	236	395,060	780	252	196,560			
1955	2,754	236	649,940	1,114	236	262,900			
1954	1,709	236	403,320	622	236	146,790			
1953	1,534	225	345,150	656	225	127,120			
1952	1,331	216	287,500	526	235	123,610			
1951	1,562	216	337,390	641	235	150,630			
1950	1,433	216	309,530	473	235	111,150			
1949	799	216	172,580	135	235	31,720			
1948	843	216	182,090	143	235	33,600			
Total	21,994	--	5,169,000	8,123	--	2,009,270	72	--	21,960

Diamond T — Chicago

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961				10	319	3,190	125	473	59,130
1960				4	319	1,270	122	473	57,710
1959				12	307	3,680	127	463	58,800
1958				16	354	5,660	187	357	66,760
1957				13	354	4,600	323	371	119,830
1956				54	375	20,250	281	451	126,730
1955				135	336	45,360	201	438	88,040
1954				133	332	44,150	92	398	36,620
1953				133	318	42,290	62	375	23,250
1952	1	260	260	91	260	23,660	68	390	26,520
1951	2	256	512	164	256	41,980	60	380	22,800
1950	10	240	2,400	137	263	36,030	45	499	22,450
1949	8	240	1,920	93	263	24,460	11	499	5,490
1948	14	240	3,360	160	263	42,080	19	499	9,480
Total	35	--	8,452	1,155	--	338,660	1,723	--	723,610

Table C-2

Vehicle Registration, Engine Displacement, and Exhaust Factor

Divco — Chicago

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	70	215	15,050	60	241	14,460			
1960	71	215	15,260	51	241	12,290			
1959	85	215	18,270	23	241	5,540			
1958	27	196	5,290	8	241	1,930			
1957	30	214	6,420	18	241	4,340			
1956	25	214	5,350	13	230	2,990			
1955	48	196	9,410	15	230	3,450			
1954	29	162	4,700	16	241	3,860			
1953	33	162	5,350	31	241	7,470			
1952	45	162	7,290	10	241	2,410			
1951	160	162	25,920	11	241	2,650			
1950	162	162	26,240						
1949	139	162	22,520	7	241	1,690			
1948	132	162	21,380	6	241	1,450			
Total	1,056	--	188,450	269	--	64,530			

Dodge-Plymouth — Chicago

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	200	267	53,400	125	274	34,250	35	360	12,600
1960	223	267	59,540	105	274	28,770	29	360	10,440
1959	264	274	72,340	176	278	48,930	22	311	6,840
1958	333	272	90,580	124	283	35,090	17	311	5,290
1957	337	265	89,300	267	272	72,620	32	316	10,110
1956	399	244	97,360	287	255	73,190	22	374	8,230
1955	421	235	98,930	376	247	92,870	12	372	4,460
1954	294	224	65,860	226	263	59,440	16	372	5,950
1953	602	224	134,850	430	274	117,820	17	372	6,320
1952	460	224	103,040	384	253	97,150	15	354	5,310
1951	513	228	116,960	475	284	134,900	15	359	5,390
1950	496	224	111,100	377	284	107,070	17	354	6,020
1949	367	224	82,210	253	255	64,520	10	273	2,730
1948	318	224	71,230	219	255	55,840	9	273	2,460
Total	5,027	--	1,246,700	3,824	--	1,022,460	268	--	92,150

Table C-3

Vehicle Registration, Engine Displacement, and Exhaust Factor

Ford — Chicago

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	1,300	223	289,900	600	257	154,200	300	378	113,400
1960	1,247	223	278,080	547	257	140,580	294	378	111,130
1959	1,852	257	475,960	973	257	250,060	506	378	191,170
1958	1,303	242	315,330	641	284	182,040	338	386	130,470
1957	1,623	247	400,881	952	247	235,140	121	302	36,540
1956	2,450	247	605,150	1,822	247	450,030	282	302	85,160
1955	1,809	249	450,440	1,310	267	349,770	123	317	38,990
1954	1,197	231	276,510	702	258	181,120	63	284	17,890
1953	1,430	227	324,610	925	293	271,020	73	317	23,140
1952	894	232	207,410	710	264	187,440	51	337	17,190
1951	947	232	219,700	717	264	189,290	93	337	31,340
1950	1,055	232	244,760	592	264	156,290	63	337	21,230
1949	605	232	140,360	288	267	79,900	6	337	2,020
1948	621	232	144,070	295	267	78,760	6	337	2,020
Total	18,333	--	4,373,160	11,074	--	2,905,640	2,300	--	821,690

G. M. C. — Chicago

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	100	287	28,700	200	305	61,000	150	353	52,950
1960	83	287	23,820	122	305	37,210	94	353	33,180
1959	173	303	52,420	328	305	100,040	309	336	103,820
1958	133	303	40,300	237	303	71,810	171	336	57,460
1957	191	286	54,630	278	308	85,620	154	503	77,460
1956	230	286	65,780	474	320	151,680	268	503	134,800
1955	195	259	50,500	312	331	103,270	174	464	80,740
1954	123	259	31,860	171	331	56,600	68	464	31,550
1953	182	262	47,680	295	286	84,370	70	464	32,480
1952	146	262	38,250	164	316	51,820	57	464	26,450
1951	135	248	33,480	205	316	64,780	112	464	51,970
1950	134	248	33,230	132	316	41,710	93	464	43,150
1949	124	248	30,750	87	313	27,230	44	451	19,840
1948	232	248	57,540	164	313	51,330	82	451	36,980
Total	2,181	--	588,840	3,169	--	988,470	1,846	--	782,830

Table C-4

Vehicle Registration, Engine Displacement, and Exhaust Factor

International — Chicago

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	500	254	127,000	550	332	182,600	500	453	226,500
1960	494	254	125,480	523	332	173,640	461	453	208,830
1959	619	242	149,800	728	340	247,520	879	465	408,740
1958	459	408	187,270	572	481	275,130	778	549	427,120
1957	535	229	122,520	567	340	192,780	923	466	430,120
1956	595	255	151,720	785	280	219,800	935	432	403,920
1955	731	255	186,410	837	280	234,360	508	432	219,460
1954	630	255	160,650	537	308	165,400	321	428	137,390
1953	643	255	163,970	552	308	170,020	282	428	120,700
1952	516	255	131,580	505	349	176,240	196	450	88,200
1951	511	255	130,300	480	349	167,520	253	450	113,850
1950	382	255	97,410	428	349	149,370	298	450	134,100
1949	341	232	79,110	318	290	92,220	96	425	40,800
1948	442	232	102,540	413	290	119,770	126	425	53,550
Total	7,398	--	1,915,760	7,795	--	2,566,370	6,556	--	3,013,280

Mack — Chicago

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961							150	459	68,850
1960							109	459	50,030
1959							262	520	136,240
1958							241	458	110,380
1957				2	401	802	312	487	151,940
1956				4	365	1,460	250	487	121,750
1955				4	311	1,240	198	487	96,430
1954				10	365	3,650	97	432	41,900
1953				4	404	1,620	99	470	46,530
1952				2	320	640	74	428	31,670
1951				15	404	6,060	126	432	54,430
1950				11	431	4,740	101	472	27,670
1949				20	354	5,080	78	472	36,820
1948				21	311	6,530	82	510	41,820
Total				93	--	31,820	2,179	--	1,016,460

Table C-5

Vehicle Registration, Engine Displacement, and Exhaust Factor

Studebaker — Chicago

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	30	252	7,560	10	289	2,890			
1960	17	252	4,280	4	289	1,160			
1959	55	252	13,860	30	289	8,670			
1958	28	223	6,240	20	263	5,260			
1957	35	230	8,050	19	284	5,400			
1956	56	228	12,770	22	259	5,700			
1955	43	219	9,420	28	225	6,160			
1954	16	207	3,310	9	245	2,200			
1953	97	207	20,080	47	245	11,520			
1952	57	207	11,800	29	245	7,100			
1951	67	207	13,870	36	245	8,820			
1950	57	170	9,690	27	235	6,340			
1949	123	170	20,910	92	245	22,540			
1948	26	170	4,420	20	245	4,900			
Total	707	--	146,260	393	--	98,660			

White — Chicago

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	7	298	2,090				200	477	95,400
1960	7	298	2,090				124	477	59,150
1959							412	504	207,650
1958							229	504	115,420
1957				9	386	3,470	331	504	166,820
1956				30	342	10,260	383	504	193,030
1955				20	363	7,260	396	504	199,580
1954				44	363	15,970	356	491	174,800
1953				122	335	40,870	328	477	156,460
1952				95	329	31,250	188	447	84,040
1951				82	329	26,980	319	447	142,600
1950				50	317	15,850	256	447	114,430
1949				51	317	16,170	170	447	75,990
1948				58	355	20,590	196	443	86,830
Total	14	--	4,180	561	--	188,670	3,888	--	1,872,200

Table C-6

Vehicle Registration, Engine Displacement, and Exhaust Factor

Willys — Chicago

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	200	180	36, 000						
1960	158	180	28, 440						
1959	135	180	24, 300						
1958	93	180	16, 740						
1957	86	180	15, 480						
1956	51	180	9, 180						
1955	58	180	10, 440						
1954	29	134	3, 890						
1953	54	134	7, 240						
1952	61	134	8, 170						
1951	78	134	10, 450						
1950	44	134	5, 900						
1949	36	134	4, 820						
1948	87	134	11, 660						
Total	1, 170	--	192, 710						

Miscellaneous — Chicago

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	325	289	93, 930				50	402	20, 100
1960	326	289	94, 210				41	402	16, 480
1959	502	289	145, 080				72	402	28, 940
1958	327	289	94, 500	1	318	318	71	402	28, 540
1957	158	289	45, 660	11	318	3, 500	102	402	41, 000
1956	95	289	27, 460	10	318	3, 180	56	402	22, 510
1955	33	289	9, 540	34	318	10, 810	68	402	27, 340
1954				27	318	8, 590	97	402	39, 000
1953	7	289	2, 020	30	318	9, 540	108	402	43, 420
1952	17	289	4, 910	9	318	2, 860	119	402	47, 840
1951	5	289	1, 440	23	318	7, 310	108	402	43, 420
1950	14	289	4, 050	24	318	7, 630	77	402	30, 950
1949	20	289	5, 780	21	318	6, 680	41	402	16, 480
1948	25	289	7, 220	26	318	8, 270	50	402	20, 100
Total	1, 854	--	535, 800	216	--	68, 690	1, 060	--	426, 100

Table C-7

Vehicle Registration, Engine Displacement, and Exhaust Factor

Chevrolet — Cincinnati

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	500	248	124,000	200	258	51,600	30	305	9,150
1960	438	248	108,620	139	258	35,860	30	305	9,150
1959	541	258	139,580	274	272	74,520			
1958	408	259	105,670	195	267	52,060			
1957	514	236	121,300	235	260	61,100			
1956	372	236	87,800	156	252	39,310			
1955	558	236	131,690	316	236	74,580			
1954	318	236	75,050	158	236	37,290			
1953	357	225	80,320	158	225	35,550			
1952	218	216	47,100	118	235	27,730			
1951	285	216	61,560	108	235	25,380			
1950	298	216	64,370	137	235	32,190			
1949	222	216	47,950	58	235	13,630			
1948	252	216	54,400	66	235	15,510			
Total	5,281	--	1,249,410	2,318	--	576,310	60	--	18,300

Diamond T — Cincinnati

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961							8	473	3,780
1960							7	473	3,310
1959							9	463	4,170
1958							2	357	714
1957							10	371	3,710
1956				1	375	375	19	451	8,570
1955				1	336	336	7	438	3,070
1954				1	332	332	4	398	1,590
1953				4	318	1,270	2	375	750
1952							2	390	780
1951				5	256	1,280	2	380	760
1950	2	240	480	3	263	790	2	499	998
1949	3	240	720	11	263	2,890	3	499	1,497
1948	1	240	240	3	263	790	1	499	499
Total	6	--	1,440	29	--	8,063	78	--	34,198

Table C-8

Vehicle Registration, Engine Displacement, and Exhaust Factor

Divco — Cincinnati

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	5	215	1,070	8	241	1,920			
1960	6	215	1,290	10	241	2,410			
1959	1	215	215	1	241	241			
1958	9	196	1,760	8	241	1,920			
1957	5	214	1,070	3	241	720			
1956	10	214	2,140	20	230	4,600			
1955	12	196	2,350	17	230	3,900			
1954	9	162	1,460	3	241	720			
1953	17	162	2,750	4	241	960			
1952	10	162	1,620	3	241	720			
1951	21	162	3,400	18	241	4,340			
1950	31	162	5,020	3	241	720			
1949	14	162	2,270	8	241	1,920			
1948	21	162	3,400	11	241	2,650			
Total	171	--	29,815	117	--	25,741			

Dodge-Plymouth — Cincinnati

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	45	262	11,790	8	274	2,190	15	360	5,400
1960	46	262	12,050	8	274	2,190	16	360	5,760
1959	40	274	10,960	8	278	2,220	7	311	2,180
1958	47	272	12,780	10	283	2,830	7	311	2,180
1957	120	265	31,800	31	272	8,430	6	316	1,900
1956	125	244	30,500	33	255	8,410	5	374	1,870
1955	132	235	31,020	25	247	6,180	1	372	370
1954	99	224	22,170	32	263	8,420			
1953	111	224	24,860	63	274	17,260			
1952	125	224	28,000	45	253	11,380	2	354	710
1951	82	228	18,700	42	284	11,930			
1950	93	224	20,830	50	284	14,200	1	354	350
1949	96	224	21,500	48	255	12,240	3	273	820
1948	118	225	26,550	59	255	15,040	3	273	820
Total	1,279	--	303,510	462	--	122,920	66	--	22,360

Table C-9

Vehicle Registration, Engine Displacement, and Exhaust Factor

Ford — Cincinnati

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	450	223	100, 350	140	257	35, 980	90	378	34, 020
1960	424	223	94, 550	133	257	34, 180	83	378	31, 370
1959	594	257	152, 700	208	257	53, 460	93	378	35, 150
1958	324	242	78, 400	114	284	32, 380	106	386	40, 920
1957	427	247	105, 470	180	247	44, 460	23	302	6, 950
1956	597	247	147, 460	295	247	72, 860	52	302	15, 700
1955	488	249	121, 500	228	267	60, 880	34	317	10, 780
1954	406	231	93, 790	160	258	41, 280	27	284	7, 670
1953	465	227	105, 560	195	293	57, 130	42	317	13, 310
1952	281	232	65, 190	152	264	40, 130	44	337	14, 830
1951	348	232	80, 730	217	264	57, 290	34	337	11, 460
1950	370	232	85, 840	181	264	47, 780	26	337	8, 760
1949	164	232	38, 050	100	267	26, 700	12	337	4, 040
1948	185	232	42, 920	114	267	30, 440	13	337	4, 380
Total	5, 523	--	1, 312, 510	2, 417	--	614, 950	679	--	239, 340

G. M. C. — Cincinnati

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	50	287	14, 350	50	305	15, 250	50	353	17, 650
1960	49	287	14, 060	48	305	14, 640	51	353	18, 000
1959	60	303	18, 180	119	303	36, 060	98	336	32, 930
1958	51	303	15, 450	32	303	9, 700	29	336	9, 740
1957	42	286	10, 010	50	308	15, 400	37	503	18, 610
1956	71	286	20, 310	76	320	24, 320	73	503	36, 720
1955	49	259	12, 690	94	331	31, 100	54	464	25, 060
1954	27	259	7, 000	46	331	15, 230	35	464	16, 240
1953	50	262	13, 100	56	286	16, 020	64	464	29, 700
1952	63	262	16, 500	57	316	18, 010	19	464	8, 800
1951	36	248	8, 930	39	316	12, 320	37	464	17, 170
1950	43	248	10, 660	63	316	19, 910	44	464	20, 420
1949	29	248	7, 190	30	313	9, 390	5	451	2, 250
1948	55	248	13, 640	56	313	17, 530	10	451	4, 510
Total	675	--	182, 070	816	--	254, 880	606	--	257, 800

Table C-10

Vehicle Registration, Engine Displacement, and Exhaust Factor

International — Cincinnati

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	90	254	22,860	75	332	24,900	100	453	45,300
1960	72	254	18,290	65	332	21,580	99	453	44,850
1959	113	242	27,350	129	340	43,860	181	465	84,160
1958	104	408	42,430	63	481	30,300	114	549	62,590
1957	114	229	26,110	52	340	17,680	160	466	74,560
1956	117	255	29,830	104	280	29,120	135	432	58,320
1955	151	255	38,500	166	280	46,480	74	432	31,970
1954	100	252	25,200	117	308	36,040	42	428	17,980
1953	91	252	22,930	122	308	37,580	55	428	23,540
1952	112	252	28,220	83	349	28,970	69	450	31,050
1951	100	252	25,200	95	349	33,160	37	450	16,650
1950	65	252	16,380	83	349	28,970	46	450	20,700
1949	77	232	17,860	61	290	17,690	24	425	10,200
1948	80	232	18,560	63	290	18,270	24	425	10,200
Total	1,386	--	359,720	1,278	--	414,600	1,160	--	532,070

Mack — Cincinnati

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961							40	459	18,360
1960							32	459	14,690
1959							104	520	54,080
1958							96	458	43,970
1957							156	487	75,970
1956							109	487	53,080
1955							97	487	47,240
1954							56	432	24,190
1953				1	363	360	36	470	16,920
1952							32	428	13,700
1951				4	363	1,450	61	432	26,350
1950							38	472	17,940
1949				1	354	350	15	472	7,080
1948				1	311	310	10	510	5,100
Total				7	--	2,470	882	--	418,670

Table C-11

Vehicle Registration, Engine Displacement, and Exhaust Factor

Studebaker — Cincinnati

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	10	264	2,640	1	264	264			
1960	10	264	2,640	1	264	264			
1959	17	252	4,280						
1958	7	223	1,560	2	263	526			
1957	7	330	2,310	2	284	568			
1956	11	228	2,510	1	259	259			
1955	33	219	7,230	4	202	810			
1954	5	207	1,040	1	245	245			
1953	33	207	6,830	10	245	2,450			
1952	26	207	5,380	7	245	1,710			
1951	31	207	6,420	12	245	2,940			
1950	31	170	5,270	13	235	3,050			
1949	61	170	10,370	23	245	5,630			
1948	16	170	2,720	6	245	1,470			
Total	298	--	61,200	83	--	20,190			

White — Cincinnati

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	2	298	596				70	477	33,390
1960	2	298	596				67	477	31,960
1959							82	504	41,330
1958							59	504	29,740
1957				1	312	312	93	504	46,870
1956				2	342	684	131	504	66,020
1955				5	363	1,820	116	504	58,460
1954				8	363	2,900	113	491	55,480
1953				14	335	4,690	83	447	37,100
1952				10	329	3,290	77	447	34,420
1951				14	329	4,600	83	447	37,100
1950				8	317	2,540	66	447	29,500
1949				14	317	4,440	48	447	21,460
1948				16	255	4,080	53	443	23,480
Total	4	--	1,190	92	--	29,360	1,141	--	546,310

Table C-12

Vehicle Registration, Engine Displacement, and Exhaust Factor

Willys

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	20	180	3,600						
1960	24	180	4,320						
1959	22	180	3,960						
1958	21	180	3,780						
1957	13	180	2,340						
1956	13	180	2,340						
1955	4	180	720						
1954	7	134	940						
1953	7	134	940						
1952	5	134	670						
1951	28	134	3,750						
1950	16	134	2,140						
1949	17	134	2,280						
1948	34	134	4,560						
Total	231	--	36,340						

Cincinnati

Miscellaneous

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	115	289	33,240				15	402	6,030
1960	116	289	33,520				16	402	6,430
1959	116	289	33,520				12	402	4,820
1958	46	289	13,290						
1957	11	289	3,180				5	402	2,010
1956	3	289	870	1	318	318	4	402	1,610
1955	1	289	289	3	318	950	1	402	402
1954				6	318	1,900	2	402	804
1953				8	318	2,540	10	402	4,020
1952	8	289	2,310	2	318	636	8	402	3,220
1951	6	289	1,730	4	318	1,270	5	402	2,010
1950	8	289	2,310	8	318	2,540	14	402	5,630
1949	2	289	578	3	318	950	2	402	804
1948	5	289	1,450	7	318	2,230	5	402	2,010
Total	437	--	126,290	42	--	13,330	99	--	39,800

Table C-13

Vehicle Registration, Engine Displacement, and Exhaust Factor

Chevrolet — New Orleans

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	300	248	74,400	100	258	25,800	24	305	7,320
1960	252	248	62,500	61	258	15,740	24	305	7,320
1959	577	258	148,870	133	272	36,180			
1958	439	259	113,700	106	267	28,300			
1957	623	236	147,030	176	260	45,760			
1956	441	236	104,080	95	252	23,940			
1955	655	236	154,580	197	236	46,490			
1954	488	236	115,170	115	236	27,140			
1953	539	225	121,270	127	225	28,570			
1952	372	216	80,350	96	235	22,560			
1951	392	216	84,670	104	235	24,440			
1950	364	216	78,620	85	235	19,970			
1949	247	216	53,350	50	235	11,750			
1948	176	216	38,020	36	235	8,460			
Total	5,865	--	1,276,610	1,481	--	365,100	48	--	14,640

Diamond T — New Orleans

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961							10	473	4,730
1960							4	473	1,890
1959				1	333	333	10	463	4,630
1958				13	357	4,640	18	357	6,430
1957							16	371	5,940
1956				5	375	1,870	13	451	5,860
1955				8	336	2,690	11	438	4,820
1954				10	332	3,320	7	398	2,790
1953				17	318	5,410	6	375	2,250
1952				15	260	3,900	20	390	7,800
1951				47	256	12,030	6	380	2,280
1950	5	240	1,200	37	263	9,730	5	499	2,490
1949	13	240	3,120	12	263	3,160	6	499	2,990
1948	17	240	4,080	16	263	4,210	8	499	3,990
Total	35	--	8,400	181	--	51,293	140	--	58,890

Table C-14

Vehicle Registration, Engine Displacement, and Exhaust Factor

Divco — New Orleans

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961									
1960									
1959									
1958									
1957									
1956									
1955	No Registration								
1954									
1953									
1952									
1951									
1950									
1949									
1948									
Total									

Dodge-Plymouth — New Orleans

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	20	262	5,240	10	274	2,740	2	360	720
1960	14	262	3,670	1	274	274	1	360	360
1959	27	274	7,400	10	278	2,780	3	311	933
1958	24	272	6,530	21	283	5,940			
1957	62	265	16,430	14	272	3,810			
1956	50	244	12,200	15	255	3,820	1	374	374
1955	106	235	24,910	22	247	5,430			
1954	50	224	11,200	18	263	4,730	2	372	744
1953	131	224	29,340	45	274	12,330	5	372	1,860
1952	118	224	26,430	38	253	9,610	2	354	708
1951	66	228	15,050	14	284	3,980	1	359	359
1950	148	224	33,150	30	284	8,520			
1949	86	224	19,260	26	255	6,630			
1948	89	224	19,940	27	255	6,880			
Total	991	--	230,750	291	--	77,474	17	--	6,058

Table C-15

Vehicle Registration, Engine Displacement, and Exhaust Factor

Ford — New Orleans

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	300	223	66,900	100	257	25,700	25	378	9,450
1960	246	223	54,860	96	257	24,670	19	378	7,180
1959	379	257	97,400	107	257	27,500	32	378	12,100
1958	316	242	76,470	121	284	34,360	58	386	22,390
1957	383	247	94,600	155	247	38,280	10	302	3,020
1956	542	247	133,870	273	247	67,430	13	302	3,930
1955	391	249	97,360	156	267	41,650	21	317	6,660
1954	346	231	79,930	173	258	44,630	5	284	1,420
1953	354	227	80,360	132	293	38,680	11	317	3,490
1952	180	232	41,760	94	264	24,820	4	337	1,350
1951	210	232	48,720	101	264	26,660	3	337	1,010
1950	249	232	57,770	81	264	21,380	5	337	1,680
1949	194	232	45,010	48	267	12,820	2	337	674
1948	137	232	31,780	33	267	8,810	2	337	674
Total	4,227	--	1,006,790	1,670	--	437,390	210	--	75,028

G. M. C. — New Orleans

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	40	287	11,480	40	305	12,200	25	353	8,830
1960	30	287	8,610	26	305	7,930	24	353	8,470
1959	70	303	21,210	69	305	21,040	29	336	9,740
1958	37	303	11,210	27	303	8,180	10	336	3,360
1957	30	286	8,580	31	308	9,550	6	503	3,020
1956	52	286	14,870	63	320	20,160	10	503	5,030
1955	40	259	10,360	32	331	10,600	11	464	5,100
1954	38	259	9,840	46	331	15,220	8	464	3,700
1953	58	262	15,200	50	286	14,300	19	464	8,820
1952	71	262	18,600	32	316	10,110	9	464	4,180
1951	78	248	19,340	29	316	9,160	10	464	4,640
1950	103	248	25,540	39	316	12,320	5	464	2,320
1949	74	248	18,350	20	313	6,260	7	451	3,160
1948	83	248	20,580	22	313	6,890	7	451	3,160
Total	804	--	213,770	526	--	163,920	180	--	73,530

Table C-16

Vehicle Registration, Engine Displacement, and Exhaust Factor

International — New Orleans

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	100	254	25,400	75	332	24,900	60	453	27,180
1960	72	254	18,290	54	332	17,930	51	453	23,100
1959	157	242	38,000	99	340	33,660	69	465	32,090
1958	108	408	44,060	107	481	51,470	56	549	30,740
1957	127	229	29,080	99	340	33,660	70	466	32,620
1956	192	255	48,960	112	280	31,360	28	432	12,100
1955	145	255	36,980	90	280	25,200	30	432	12,960
1954	126	252	31,750	96	308	29,570	19	428	8,130
1953	84	252	21,170	91	308	28,030	14	428	6,000
1952	112	252	28,220	108	349	37,690	16	450	7,200
1951	107	252	27,000	72	349	25,130	13	450	5,850
1950	108	252	27,220	76	349	26,520	13	450	5,850
1949	81	232	18,790	69	290	20,010	13	425	5,530
1948	82	232	19,020	70	290	20,300	14	425	5,950
Total	1,601	--	413,940	1,218	--	405,430	466	--	215,300

Mack — New Orleans

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961							10	459	4,590
1960							6	459	2,750
1959							23	520	11,960
1958							18	458	8,240
1957				2	401	802	24	487	11,690
1956							49	487	23,860
1955							29	487	14,120
1954							10	432	4,320
1953							19	470	8,930
1952				2	293	586	22	428	9,420
1951				1	379	379	6	432	2,590
1950				2	419	838	11	472	5,190
1949				10	354	3,540	5	472	2,360
1948				9	311	2,799	5	510	2,550
Total				26	--	8,944	237	--	112,570

Table C-17

Vehicle Registration, Engine Displacement, and Exhaust Factor

Studebaker — New Orleans

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	5	252	1,260						
1960	5	252	1,260						
1959	4	252	1,010						
1958	6	223	1,340						
1957	7	230	1,610						
1956	10	228	2,280	1	259	259			
1955	10	219	2,190	1	202	202			
1954	11	207	2,280	3	245	735			
1953	41	207	8,490	18	245	4,410			
1952	30	207	6,210	14	245	3,430			
1951	29	207	6,000	10	245	2,450			
1950	25	170	4,250	8	235	1,880			
1949	42	170	7,140	17	245	4,160			
1948	8	170	1,360	3	245	735			
Total	233	--	46,680	75	--	18,260			

White — New Orleans

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961							15	477	7,160
1960							13	477	6,200
1959							42	504	21,170
1958							32	504	16,130
1957				2	362	720	26	504	13,100
1956				3	362	1,090	20	504	10,080
1955				8	342	2,740	41	504	20,660
1954				3	363	1,090	24	491	11,780
1953				16	335	5,360	24	477	11,450
1952				29	329	9,540	29	477	13,830
1951				1	329	329	28	477	13,360
1950				9	317	2,850	21	477	10,020
1949				8	317	2,540	18	477	8,590
1948				7	355	2,490	18	443	7,970
Total				86	--	28,750	351	--	171,500

Table C-18

Vehicle Registration, Engine Displacement, and Exhaust Factor

Willys — New Orleans

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	10	180	1,800						
1960	11	180	1,980						
1959	8	180	1,440						
1958	6	180	1,080						
1957	3	180	540						
1956	3	180	540						
1955	1	180	180						
1954	1	134	134						
1953	5	134	670						
1952	4	134	540						
1951	14	134	1,880						
1950	15	134	2,010						
1949	22	134	2,950						
1948	12	134	1,610						
Total	115	--	17,350						

Miscellaneous — New Orleans

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	80	289	23,120				2	402	804
1960	70	289	20,230				2	402	804
1959	153	289	44,210				4	402	1,610
1958	59	289	17,050						
1957	11	289	3,180	1	318	318			
1956	7	289	2,020						
1955	5	289	1,450	2	318	636	3	402	1,210
1954				5	318	1,590	2	402	804
1953				2	318	636	4	402	1,610
1952	2	289	580	5	318	1,590	7	402	2,810
1951				1	318	318	7	402	2,810
1950	4	289	1,160	4	318	1,270	2	402	804
1949	6	289	1,730	3	318	950	1	402	402
1948	4	289	1,160	2	318	636	1	402	402
Total	401	--	115,890	25	--	7,944	35	--	14,070

Table C-19

Vehicle Registration, Engine Displacement, and Exhaust Factor

Chevrolet — Philadelphia

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	550	248	136,400	125	258	32,250	8	305	2,440
1960	506	248	125,480	110	258	28,380	8	305	2,440
1959	690	258	178,020	154	272	41,900			
1958	732	259	189,600	142	267	37,900			
1957	833	236	196,600	189	260	49,140			
1956	802	236	189,270	144	252	36,280			
1955	1,043	236	246,150	231	236	54,500			
1954	753	236	177,700	164	236	38,700			
1953	666	225	149,850	156	225	35,100			
1952	509	216	109,940	132	235	31,000			
1951	699	216	150,980	125	235	29,370			
1950	644	216	139,100	165	235	38,770			
1949	450	216	97,200	90	235	21,150			
1948	402	216	86,830	81	235	19,030			
Total	9,279	--	2,173,120	2,008	--	493,470	16	--	4,880

Diamond T — Philadelphia

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961							18	473	3,780
1960							6	473	2,830
1959							2	463	926
1958							11	357	5,090
1957							8	371	2,968
1956				4	375	1,500	16	451	7,220
1955				3	336	1,000	5	438	2,190
1954				6	332	1,990	1	398	398
1953				1	318	318	2	375	750
1952				5	260	1,300	5	390	1,950
1951				15	256	3,840	3	380	1,140
1950	2	240	480	8	263	2,100	3	499	1,500
1949	1	240	240	8	263	2,100	1	499	449
1948	3	240	720	13	263	3,420	1	499	449
Total	6	--	1,440	63	--	17,568	82	--	31,640

Table C-20

Vehicle Registration, Engine Displacement, and Exhaust Factor

Divco — Philadelphia

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	60	215	12,900	5	241	1,200			
1960	53	215	11,390	1	241	241			
1959	24	215	5,160	6	241	1,440			
1958	30	196	5,880	9	241	2,170			
1957	22	214	4,700	1	241	241			
1956	33	214	7,060	9	230	2,070			
1955	39	196	7,640	3	230	690			
1954	82	162	13,280	8	241	1,930			
1953	32	162	5,180	4	241	964			
1952	77	162	12,470	21	241	5,060			
1951	112	162	18,140	10	241	2,410			
1950	125	162	20,250	1	241	241			
1949	43	162	6,970						
1948	117	162	18,950						
Total	849	--	149,970	78	--	18,657			

Dodge-Plymouth — Philadelphia

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	140	267	37,380	60	274	16,440	19	360	6,840
1960	134	267	35,780	58	274	15,890	19	360	6,840
1959	144	274	39,450	111	278	30,850	19	311	5,900
1958	157	272	42,700	72	283	20,376	41	311	12,750
1957	220	265	58,300	116	272	31,550	26	316	8,220
1956	249	244	60,750	144	255	36,720	11	374	4,110
1955	201	235	47,230	154	247	38,030	23	372	8,550
1954	323	224	72,350	229	263	60,220	21	372	7,800
1953	201	224	45,020	162	274	44,390	6	372	2,230
1952	268	224	60,030	145	253	36,680	9	354	3,180
1951	285	228	64,980	149	284	42,310	32	359	11,480
1950	219	224	49,050	98	284	27,830	5	354	1,770
1949	211	224	47,260	116	255	29,580	5	373	1,860
1948	193	224	43,230	106	255	27,030	5	373	1,860
Total	2,945	--	703,510	1,720	--	457,896	241	--	83,390

Table C-21

Vehicle Registration, Engine Displacement, and Exhaust Factor

Ford — Philadelphia

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	450	223	100, 350	200	257	51, 400	70	378	26, 460
1960	449	223	100, 130	209	257	53, 700	68	378	25, 700
1959	616	257	158, 310	228	257	58, 600	90	378	34, 020
1958	449	242	108, 660	119	254	30, 220	33	386	12, 740
1957	556	247	137, 330	176	247	43, 470	23	302	6, 940
1956	1, 192	247	294, 420	471	247	116, 340	93	302	28, 080
1955	869	249	216, 380	259	267	69, 150	48	317	15, 210
1954	562	231	129, 820	250	258	64, 500	48	284	13, 630
1953	837	227	190, 000	301	293	88, 190	64	317	20, 290
1952	496	232	115, 070	318	264	83, 950	65	337	21, 900
1951	535	232	124, 120	314	264	82, 900	50	337	16, 850
1950	824	232	191, 170	390	264	102, 960	53	337	11, 860
1949	271	232	62, 870	160	267	42, 720	8	337	2, 690
1948	393	239	93, 920	232	267	61, 940	11	337	3, 650
Total	8, 499	--	2, 022, 550	3, 627	--	950, 040	724	--	246, 020

G. M. C. — Philadelphia

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	140	287	40, 180	140	305	42, 700	100	353	35, 300
1960	138	287	39, 600	148	305	45, 140	102	353	36, 000
1959	142	303	43, 020	140	305	42, 700	108	336	36, 280
1958	210	303	63, 630	130	303	39, 390	143	336	48, 050
1957	186	286	53, 190	146	308	44, 960	118	503	59, 350
1956	156	286	44, 600	164	320	52, 480	94	503	47, 280
1955	163	259	42, 220	262	331	86, 720	63	464	29, 230
1954	206	259	53, 350	132	331	43, 690	61	464	28, 300
1953	116	262	30, 400	108	286	30, 890	27	464	12, 530
1952	120	262	31, 440	101	316	31, 910	28	464	12, 990
1951	156	248	38, 680	119	316	37, 600	49	464	22, 730
1950	158	248	39, 180	77	316	24, 330	13	464	6, 030
1949	128	248	31, 740	61	313	19, 090	25	451	11, 270
1948	126	248	31, 240	60	313	18, 780	24	451	10, 820
Total	2, 145	--	582, 470	1, 788	--	560, 380	955	--	396, 160

Table C-22

Vehicle Registration, Engine Displacement, and Exhaust Factor

International — Philadelphia

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	230	254	58, 420	250	332	83, 000	230	453	104, 190
1960	230	254	58, 420	251	332	83, 330	233	453	105, 550
1959	238	242	57, 600	203	340	69, 020	236	465	109, 740
1958	206	408	84, 050	270	481	129, 870	163	549	89, 480
1957	244	229	55, 870	210	340	71, 400	191	466	89, 000
1956	332	255	84, 660	235	280	65, 800	148	432	63, 930
1955	293	255	74, 700	296	280	82, 880	73	432	31, 530
1954	321	252	80, 890	398	308	122, 580	99	428	42, 370
1953	180	252	45, 360	128	308	39, 420	35	428	14, 980
1952	251	252	63, 250	144	349	50, 250	33	450	14, 850
1951	171	252	43, 090	165	349	57, 580	38	450	17, 100
1950	161	252	40, 570	128	349	44, 670	19	450	8, 550
1949	123	232	28, 530	85	290	24, 650	18	425	7, 650
1948	124	232	28, 760	85	290	24, 650	18	425	7, 650
Total	3, 104	--	804, 170	2, 848	--	949, 100	1, 534	--	706, 570

Mack — Philadelphia

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961							280	459	128, 520
1960							288	459	132, 190
1959							229	520	119, 080
1958							253	458	115, 870
1957				7	432	3, 020	285	487	138, 800
1956				3	365	1, 090	223	487	108, 600
1955				10	311	3, 110	247	487	120, 290
1954				18	387	6, 970	166	432	71, 710
1953				2	379	760	65	470	30, 550
1952				1	293	293	80	428	34, 240
1951				22	354	7, 790	119	432	51, 400
1950				14	431	6, 030	75	472	35, 400
1949				25	354	8, 850	44	472	20, 770
1948				34	311	10, 570	62	510	31, 620
Total				136	--	48, 483	2, 416	--	1, 139, 040

Table C-23

Vehicle Registration, Engine Displacement, and Exhaust Factor

Studebaker — Philadelphia

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	15	252	3,780						
1960	16	252	4,030						
1959	13	252	3,280						
1958	12	223	2,680						
1957	2	230	460	5	284	1,420			
1956	12	228	2,730	2	259	520			
1955	11	219	2,400	5	202	1,010			
1954	21	207	4,340	16	245	3,920			
1953	15	207	3,100	10	245	2,450			
1952	19	207	3,930	14	245	3,430			
1951	18	207	3,720	15	245	3,670			
1950	21	170	3,570	12	235	2,820			
1949	26	170	4,420	22	245	5,390			
1948	23	170	3,910	20	245	4,900			
Total	224	--	46,350	121	--	29,530			

White — Philadelphia

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	2	298	596				230	477	109,710
1960	2	298	596				224	477	100,130
1959							253	504	127,510
1958							195	504	98,280
1957				7	362	2,530	317	504	159,800
1956				15	342	5,130	208	504	104,830
1955				18	363	6,530	176	504	88,700
1954				77	363	27,950	285	491	139,940
1953				37	335	12,390	107	477	51,040
1952				31	329	10,200	102	477	48,650
1951				30	329	9,870	169	477	80,610
1950				42	317	13,310	102	477	48,650
1949				18	317	5,700	65	477	31,000
1948				22	317	6,970	79	443	35,000
Total	4	--	1,192	297	--	100,580	2,512	--	1,223,850

Table C-24

Vehicle Registration, Engine Displacement, and Exhaust Factor

Willys — Philadelphia

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	50	180	9,000						
1960	57	180	10,260						
1959	50	180	9,000						
1958	48	180	8,640						
1957	24	180	4,320						
1956	9	180	1,620						
1955	11	180	1,980						
1954	24	134	3,210						
1953	21	134	2,810						
1952	36	134	4,820						
1951	24	134	3,210						
1950	36	134	4,820						
1949	23	134	3,080						
1948	40	134	5,360						
Total	453	--	72,130						

Miscellaneous — Philadelphia

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	80	289	23,120				10	402	4,020
1960	68	289	19,650				7	402	2,810
1959	299	289	86,410				26	402	10,450
1958	220	289	63,580				16	402	6,430
1957	90	289	26,010	6	318	1,900	25	402	10,050
1956	38	289	10,980	8	318	2,540	47	402	18,890
1955	5	289	1,440	20	318	6,360	84	402	33,770
1954	1	289	289	18	318	5,720	138	402	55,470
1953	1	289	289	9	318	2,860	107	402	43,010
1952	3	289	870	12	318	3,810	84	402	33,770
1951	4	289	1,150	17	318	5,400	91	402	36,580
1950	4	289	1,150	10	318	3,180	65	402	26,130
1949	5	289	1,440	12	318	3,810	22	402	8,840
1948	10	289	2,890	26	318	8,270	51	402	20,500
Total	828	--	239,268	138	--	43,850	773	--	310,720

Table C-25

Vehicle Registration, Engine Displacement, and Exhaust Factor

Chevrolet — Washington, D. C.

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	400	248	99,200	100	258	25,800	9	305	2,750
1960	369	248	91,510	91	258	23,480	9	305	2,750
1959	571	258	147,320	157	272	42,700			
1958	470	259	121,730	100	267	26,700			
1957	533	236	129,790	133	260	34,580			
1956	385	236	90,860	127	252	32,000			
1955	593	236	139,950	166	236	39,180			
1954	321	236	75,760	93	236	21,950			
1953	372	225	83,700	103	235	24,210			
1952	280	216	60,480	97	235	22,800			
1951	399	216	86,180	119	235	27,970			
1950	347	216	74,950	67	235	15,740			
1949	222	216	47,950	41	235	9,640			
1948	174	216	37,580	32	235	7,520			
Total	5,436	--	1,286,960	1,426	--	354,270	18	--	5,500

Diamond T — Washington, D. C.

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961							7	473	3,310
1960							9	473	4,260
1959							5	463	2,310
1958							9	357	3,210
1957							2	371	740
1956									
1955									
1954							1	398	400
1953							1	375	380
1952							1	390	390
1951				2	256	510	2	380	760
1950	2	240	480	9	263	2,370	4	499	2,000
1949				3	263	790	1	499	500
1948				6	263	1,580	1	499	500
Total	2	--	480	20	--	5,250	43	--	18,760

Table C-26

Vehicle Registration, Engine Displacement, and Exhaust Factor

Divco — Washington, D. C.

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	50	215	10,750	6	241	1,450			
1960	46	215	9,890	6	241	1,450			
1959	39	215	8,360	6	241	1,450			
1958	16	196	3,140	6	241	1,450			
1957	24	214	5,140	2	241	480			
1956	45	214	9,630	2	230	460			
1955	20	196	3,920	7	230	1,610			
1954	22	196	4,310	11	241	2,650			
1953	22	162	3,560	11	241	2,650			
1952	25	162	4,050	9	241	2,170			
1951	36	162	5,830						
1950	55	162	8,910	2	241	480			
1949	44	162	7,130	2	241	480			
1948	60	162	9,720	2	241	480			
Total	504	--	94,340	72	--	17,260			

Dodge - Plymouth — Washington, D. C.

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	40	267	10,680	5	274	1,370	2	360	720
1960	50	267	13,350	10	274	2,740	1	360	360
1959	79	274	21,650	15	278	4,170	8	311	2,490
1958	73	272	19,860	28	283	7,920	6	311	1,870
1957	65	265	17,230	10	272	2,720	2	316	630
1956	85	244	20,740	38	255	9,690	2	374	750
1955	85	235	19,980	35	247	8,650			
1954	52	224	11,650	32	263	8,420			
1953	98	224	21,950	61	247	15,070			
1952	167	224	37,400	91	263	23,930	1	354	350
1951	83	228	18,920	45	284	12,780			
1950	96	224	21,500	31	284	8,800	1	354	350
1949	74	224	16,580	35	255	8,930	1	273	270
1948	71	224	15,900	33	255	8,420	1	273	270
Total	1,118	--	267,390	469	--	123,610	25	--	8,060

Table C-27

Vehicle Registration, Engine Displacement, and Exhaust Factor

Ford — Washington, D. C.

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	300	223	66,900	110	257	28,270	40	378	15,120
1960	267	223	59,540	106	257	27,240	34	378	12,850
1959	426	257	109,480	219	257	56,280	76	378	28,730
1958	369	242	89,300	128	284	36,350	60	386	23,760
1957	387	247	95,590	140	247	34,580	25	302	7,550
1956	563	247	139,060	220	247	54,340	41	302	12,380
1955	378	249	94,120	141	267	37,650	22	317	6,970
1954	230	231	53,130	135	258	34,830	8	284	2,270
1953	258	227	58,570	88	293	25,780	14	317	4,440
1952	174	232	40,370	142	264	37,490	13	337	4,380
1951	225	232	52,200	141	264	37,220	33	337	11,120
1950	208	232	48,260	112	264	29,570	11	337	3,710
1949	147	232	34,100	79	267	21,090	9	337	3,030
1948	159	232	36,890	85	267	22,700	9	337	3,030
Total	4,091	--	977,510	1,846	--	483,390	395	--	139,340

G. M. C. — Washington, D. C.

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	40	287	11,480	60	305	18,300	30	353	10,590
1960	34	287	9,758	53	305	16,170	23	353	8,120
1959	55	303	16,670	147	303	44,540	82	336	27,550
1958	63	303	19,090	85	303	25,760	46	336	15,460
1957	85	286	24,310	89	308	27,410	25	503	12,570
1956	77	286	22,020	122	320	39,040	42	503	21,130
1955	60	259	15,540	146	331	48,330	41	464	19.020
1954	31	259	8,030	57	331	18,870	9	464	4,180
1953	63	262	16,510	84	286	24,020	23	464	10,670
1952	67	262	17,550	76	316	24,020	16	464	7,420
1951	79	248	19,590	113	316	35,700	24	464	11,140
1950	68	248	16,860	69	316	21,800	24	464	11,140
1949	45	248	11,160	28	313	8,760	4	451	1,800
1948	43	248	10,660	26	313	8,140	4	451	1,800
Total	810	--	219,228	1,155	--	360,860	393	--	162,590

Table C-28

Vehicle Registration, Engine Displacement, and Exhaust Factor

International — Washington, D. C.

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	65	254	16,510	35	332	11,620	30	453	13,590
1960	62	254	15,750	30	332	9,960	25	453	11,330
1959	105	242	25,410	51	340	17,340	108	465	50,220
1958	65	408	26,520	49	481	23,570	63	549	34,590
1957	69	229	15,800	41	340	13,940	70	466	32,620
1956	90	255	22,950	74	280	20,720	93	432	40,170
1955	103	255	26,260	97	280	27,160	38	432	16,420
1954	87	252	21,920	65	308	20,020	6	428	2,570
1953	98	252	24,700	60	308	18,480	13	428	5,560
1952	94	252	23,690	63	249	15,690	5	450	2,250
1951	127	252	32,000	67	249	16,680	18	450	8,100
1950	84	252	21,170	56	249	13,940	13	450	5,850
1949	37	232	8,580	28	290	8,120	5	425	2,120
1948	56	232	12,990	42	290	12,180	8	425	3,400
Total	1,142	--	294,250	758	--	229,420	495	--	228,790

Mack — Washington, D. C.

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961							100	459	45,900
1960							98	459	44,980
1959							54	520	28,080
1958							65	458	29,770
1957							66	487	32,140
1956							63	487	30,680
1955				1	311	311	18	487	8,770
1954				2	416	832	17	432	7,340
1953							23	470	10,810
1952							24	428	10,270
1951				4	404	1,616	15	432	6,480
1950				1	451	451	20	472	9,440
1949				2	354	708	11	472	5,190
1948				3	311	933	24	510	12,240
Total				13	--	4,851	598	--	282,090

Table C-29

Vehicle Registration, Engine Displacement, and Exhaust Factor

Studebaker — Washington, D. C.

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	4	252	1,008						
1960	4	252	1,008						
1959	4	252	1,008						
1958									
1957	2	230	460	1	284	284			
1956	8	228	1,820						
1955	8	219	1,750						
1954	4	207	828	1	245	245			
1953	6	207	1,240	5	245	1,225			
1952	11	207	2,280	4	245	980			
1951	13	207	2,690	7	245	1,715			
1950	6	170	1,020	8	235	1,880			
1949	12	170	2,040	8	245	1,960			
1948	4	170	680	2	245	490			
Total	86	--	17,832	36	--	8,779			

White — Washington, D. C.

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	1	298	298				20	477	9,540
1960	1	298	298				18	477	8,590
1959							33	504	16,630
1958							18	504	9,070
1957				2	342	684	49	504	24,700
1956				8	342	2,740	51	504	25,700
1955				33	363	11,980	35	504	17,640
1954				19	363	6,900	34	491	16,690
1953							33	477	15,740
1952				4	229	916	33	447	14,750
1951				19	229	4,350	22	447	9,830
1950				5	317	1,590	9	447	4,020
1949				7	317	2,220	10	447	4,470
1948				12	355	4,260	15	443	6,650
Total	2	--	596	109	--	35,640	380	--	184,020

Table C-30

Vehicle Registration, Engine Displacement, and Exhaust Factor

Willys — Washington, D. C.

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	20	180	3,600						
1960	22	180	3,960						
1959	19	180	3,420						
1958	25	180	4,500						
1957	16	180	2,880						
1956	19	180	3,420						
1955	7	180	1,260						
1954	7	134	940						
1953	11	134	1,470						
1952	9	134	1,210						
1951	24	134	3,220						
1950	21	134	2,810						
1949	9	134	1,210						
1948	16	134	2,140						
Total	225	--	36,040						

Miscellaneous — Washington, D. C.

Year Model	Light Weight			Medium Weight			Heavy Weight		
	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h	N_h	C_h	N_hC_h
1961	100	289	28,900				1	402	402
1960	95	289	27,460				1	402	402
1959	201	289	58,090				4	402	1,608
1958	91	289	26,300				1	402	402
1957	21	289	6,070	4	318	1,270	2	402	804
1956	6	289	1,730	4	318	1,270	5	402	2,010
1955				6	318	1,910	11	402	4,420
1954				1	318	318	1	402	402
1953	1	289	289	1	318	318	9	402	3,620
1952	1	289	289	1	318	318	6	402	2,410
1951	3	289	870	3	318	950	5	402	2,010
1950	1	289	289	1	318	318	3	402	1,210
1949	3	289	870	4	318	1,270	8	402	3,220
1948	1	289	289	1	318	318	3	402	1,210
Total	524	--	151,446	26	--	8,260	60	--	24,130

Table C-31

SELECTION OF 100 VEHICLES FROM A TOTAL OF 116, 333 TRUCKS AND BUSES REGI

Values for $n_h = \frac{N_h C_h}{\sum_{1}^{504} N_h C_h}$ 100 where $\sum_{1}^{504} N_h C_h =$ 3

Vehicle Make	Weight Class	YEAR MODELS								
		1961	1960	1959	1958	1957	1956	1955	1954	
Chevrolet	Light	(1)1.04	(1)0.97	(1)1.57	(1)1.26	(1)1.40	(1)1.18	(2)1.94	(1)1.21	(1)
	Medium	0.31	0.30	(1)0.70	(1)0.48	(1)0.68	(1)0.59	(1)0.79	0.44	
	Heavy	0.03	0.03							
Diamond T	Light									
	Medium	0.01	0.00+	0.01	0.02	0.01	0.06	(1)0.14	0.13	
	Heavy	0.18	0.17	0.18	0.20	(1)0.36	(1)0.38	0.26	0.11	
Divco	Light	0.05	0.05	0.05	0.01	0.01	0.02	0.03	0.01	
	Medium	0.04	0.04	0.02	0.00	0.01	0.01	0.01	0.01	
	Heavy									
Dodge-Plymouth	Light	0.16	0.18	0.22	(1)0.27	0.27	(1)0.29	0.30	0.20	(1)
	Medium	0.10	0.09	0.15	0.10	(1)0.22	0.22	0.28	0.18	(1)
	Heavy	0.04	(1)0.03	0.02	0.02	0.03	0.02	0.01	0.02	
Ford	Light	(1)0.87	(1)0.83	(1)1.42	(1)0.94	(1)1.20	(2)1.81	(1)1.35	(1)0.82	(1)
	Medium	0.46	0.42	(1)0.75	(1)0.54	(1)0.70	(1)1.35	(1)1.05	(1)0.54	(1)
	Heavy	(1)0.34	0.33	(1)0.57	(1)0.39	0.11	0.25	0.12	0.05	
G. M. C.	Light	0.09	0.07	0.16	0.12	0.16	(1)0.20	0.15	0.10	
	Medium	0.18	0.11	(1)0.30	0.21	0.26	(1)0.45	(1)0.31	0.17	
	Heavy	0.16	0.10	(1)0.31	0.17	0.23	(1)0.40	(1)0.24	0.09	
International	Light	0.38	0.38	(1)0.45	(1)0.56	0.37	(1)0.45	(1)0.56	(1)0.48	(1)
	Medium	(1)0.55	0.52	(1)0.74	(1)0.83	(1)0.58	(1)0.66	(1)0.70	0.49	
	Heavy	(1)0.68	(1)0.62	(1)1.22	(1)1.28	(1)1.29	(1)1.21	(1)0.66	(1)0.41	
Mack	Light									
	Medium					0.00+	0.01	0.00+	0.01	
	Heavy	0.21	0.15	(1)0.41	(1)0.33	(1)0.46	0.37	0.27	0.13	
Studebaker	Light	0.02	0.01	(1)0.04	0.02	0.02	0.04	0.03	0.01	
	Medium	0.01	0.01	0.03	0.01	0.02	0.02	0.02	0.01	
	Heavy									
White	Light	0.01	0.01							
	Medium					0.10	0.03	0.02	0.05	(1)
	Heavy	0.28	0.18	(1)0.62	0.34	(1)0.50	(1)0.58	(1)0.60	(1)0.52	
Willys	Light	(1)0.11	0.08	0.07	0.06	0.05	0.03	0.03	0.01	
	Medium									
	Heavy									
Miscellaneous	Light	0.28	(1)0.28	(1)0.43	0.28	0.14	0.08	0.03		
	Medium				0.00+	0.01	0.01	0.03	0.03	
	Heavy	0.06	0.05	0.09	0.08	0.12	0.07	0.08	0.12	
Totals	Light	(3)	(3)	(5)	(4)	(2)	(6)	(4)	(3)	(4)
	Medium	(1)	(0)	(4)	(3)	(4)	(4)	(5)	(1)	(3)
	Heavy	(2)	(2)	(5)	(3)	(4)	(4)	(3)	(2)	(0)
Grand Totals		(6)	(5)	(14)	(10)	(10)	(14)	(12)	(6)	(7)

Note: Figures in parenthesis indicate vehicle selection as described in text for report period en

Table C-31

L OF 116,333 TRUCKS AND BUSES REGISTERED IN COOK COUNTY, ILLINOIS (CHICAGO)

or $n_h = \frac{N_h C_h}{\sum_{1}^{504} N_h C_h}$ 100 where $\sum_{1}^{504} N_h C_h = 33,422,832$

YEAR MODELS											
1957	1956	1955	1954	1953	1952	1951	1950	1949	1948	Totals	Rounded Totals
(1)1.40	(1)1.18	(2)1.94	(1)1.21	(1)1.03	(1)0.86	(1)1.01	(1)0.93	(1)0.52	(1)0.54	15.46	15
(1)0.68	(1)0.59	(1)0.79	0.44	0.38	0.37	(1)0.45	0.33	0.09	0.10	6.01	6
										0.06	0
										21.53	21
					0.00+	0.00+	0.01	0.01	0.01	0.03	0
0.01	0.06	(1)0.14	0.13	0.13	0.07	0.13	0.11	0.07	0.13	1.02	1
(1)0.36	(1)0.38	0.26	0.11	0.07	0.08	0.07	0.07	0.02	0.03	2.18	2
										3.23	3
0.01	0.02	0.03	0.01	0.02	0.02	(1)0.08	0.07	0.06	0.06	0.54	1
0.01	0.01	0.01	0.01	0.02	0.01	0.01		0.01	0.01	0.20	0
											0
										0.74	1
0.27	(1)0.29	0.30	0.20	(1)0.40	0.31	(1)0.35	0.33	0.24	0.21	3.73	4
(1)0.22	0.22	0.28	0.18	(1)0.35	0.29	(1)0.40	0.32	0.19	0.17	3.06	3
0.03	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.29	1
										7.08	8
(1)1.20	(2)1.81	(1)1.35	(1)0.82	(1)0.97	(1)0.62	0.66	(1)0.73	0.42	0.43	13.07	12
(1)0.70	(1)1.35	(1)1.05	(1)0.54	(1)0.81	(1)0.56	(1)0.57	0.47	0.24	0.24	8.70	9
0.11	0.25	0.12	0.05	0.07	0.05	0.09	0.06	0.01	0.01	2.45	3
										24.22	24
0.16	(1)0.20	0.15	0.10	0.14	0.12	0.10	0.10	0.09	0.17	1.77	1
0.26	(1)0.45	(1)0.31	0.17	0.25	0.16	0.19	0.12	0.08	0.15	2.94	3
0.23	(1)0.40	(1)0.24	0.09	0.10	0.08	0.16	0.13	0.06	0.11	2.34	3
										7.05	7
0.37	(1)0.45	(1)0.56	(1)0.48	(1)0.49	0.39	0.39	0.29	0.24	0.31	5.74	6
(1)0.58	(1)0.66	(1)0.70	0.49	0.51	(1)0.53	0.50	0.45	0.27	0.36	7.69	7
(1)1.29	(1)1.21	(1)0.66	(1)0.41	0.36	0.26	0.34	(1)0.40	0.12	0.16	9.01	9
										22.44	22
											0
0.00+	0.01	0.00+	0.01	0.01	0.00+	0.02	0.01	0.02	0.02	0.10	0
(1)0.46	0.37	0.27	0.13	0.14	0.10	0.16	0.08	0.11	0.13	3.05	3
										3.15	3
0.02	0.04	0.03	0.01	0.06	0.04	0.04	0.02	0.06	0.01	0.41	1
0.02	0.02	0.02	0.01	0.03	0.02	0.03	0.02	0.07	0.01	0.31	0
											0
										0.72	1
										0.02	0
0.10	0.03	0.02	0.05	(1)0.12	0.09	0.08	0.05	0.05	0.06	0.56	1
(1)0.50	(1)0.58	(1)0.60	(1)0.52	0.47	0.25	0.43	0.34	0.23	0.26	5.60	5
										6.18	6
0.05	0.03	0.03	0.01	0.02	0.02	0.03	0.02	0.01	0.03	0.57	1
											0
											0
										0.57	1
0.14	0.08	0.03		0.01	0.01	0.00+	0.01	0.02	0.02	1.59	2
0.01	0.01	0.03	0.03	0.03	0.01	0.02	0.02	0.02	0.02	0.20	0
0.12	0.07	0.08	0.12	0.13	(1)0.14	0.13	0.09	0.05	0.06	1.27	1
										3.06	3
	(6)	(4)	(3)	(4)	(2)	(3)	(2)	(1)	(1)	42.93	43
	(4)	(5)	(1)	(3)	(2)	(3)	(0)	(0)	(0)	30.79	30
	(4)	(3)	(2)	(0)	(1)	(0)	(1)	(0)	(0)	26.25	27
	(14)	(12)	(6)	(7)	(5)	(6)	(3)	(1)	(1)	99.97	100

as described in text for report period ending December 1, 1961.

Table C-32

SELECTION OF 100 VEHICLES FROM A TOTAL OF 27,723 TRUCKS AND BUSES

Values for $n_h = \frac{N_h C_h}{\sum_{1}^{504} N_h C_h}$ 100 where $\sum$

Vehicle Make	Weight Class	YEAR MODEL							
		1961	1960	1959	1958	1957	1956	1955	195
Chevrolet	Light	(1)1.58	(1)1.38	(2)1.78	(1)1.34	(1)1.54	(1)1.12	(2)1.68	(1)0.
	Medium	(1)0.66	0.46	(1)0.95	(1)0.66	(1)0.78	(1)0.50	(1)0.95	0.
	Heavy	0.12	(1)0.12						
Diamond T	Light								
	Medium						0.00+	0.01	0.
	Heavy	0.05	0.04	0.05	0.01	0.05	(1)0.11	0.04	0.
Divco	Light	0.01	0.02	0.00+	0.02	0.02	0.03	0.03	0.
	Medium	0.02	0.03	0.00+	0.03	0.01	0.06	0.05	0.
	Heavy								
Dodge-Plymouth	Light	0.15	0.15	0.14	0.16	(1)0.40	0.39	(1)0.39	0.
	Medium	0.03	0.03	0.03	0.03	(1)0.11	0.11	0.08	0.
	Heavy	0.07	(1)0.07	0.03	0.03	0.02	0.02	0.00+	
Ford	Light	(1)1.28	(1)1.20	(2)1.94	(1)1.00	(1)1.34	(2)1.88	(2)1.55	(1)1.
	Medium	0.46	0.44	(1)0.68	0.41	(1)0.57	(1)0.93	(1)0.77	(1)0.
	Heavy	(1)0.43	0.40	(1)0.45	(1)0.52	0.09	0.20	0.14	0.
G. M. C.	Light	0.18	0.19	(1)0.23	0.20	0.13	(1)0.26	0.16	0.
	Medium	0.19	0.19	(1)0.46	0.12	0.20	(1)0.31	(1)0.39	0.
	Heavy	0.22	0.23	(1)0.42	0.12	0.24	(1)0.47	(1)0.32	0.
International	Light	0.29	0.23	0.35	(1)0.54	0.33	(1)0.38	(1)0.49	0.
	Medium	0.32	0.27	(1)0.56	(1)0.39	0.22	0.37	(1)0.59	(1)0.
	Heavy	(1)0.58	(1)0.57	(1)1.07	(1)0.80	(1)0.95	(1)0.74	0.41	0.
Mack	Light								
	Medium								
	Heavy	0.23	0.19	(1)0.69	(1)0.56	(1)0.97	(1)0.67	(1)0.60	(1)0.
Studebaker	Light	0.03	0.03	0.06	0.02	0.03	0.03	0.09	0.
	Medium	0.00+	0.01		0.01	0.01	0.00+	0.01	0.
	Heavy								
White	Light	0.01	0.01						
	Medium					0.00+	0.01	0.02	0.
	Heavy	(1)0.43	0.41	(1)0.52	0.38	(1)0.60	0.34	(1)0.74	(1)0.
Willys	Light	0.05	0.05	0.05	0.05	0.03	0.03	0.01	0.
	Medium								
	Heavy								
Miscellaneous	Light	0.42	(1)0.43	(1)0.43	0.17	0.04	0.01	0.00+	
	Medium						0.00+	0.01	0.
	Heavy	0.08	(1)0.08	0.06		0.03	0.02	0.01	0.
Totals	Light	(2)	(3)	(6)	(3)	(3)	(5)	(6)	(2)
	Medium	(1)	(0)	(4)	(2)	(3)	(3)	(4)	(2)
	Heavy	(3)	(4)	(5)	(3)	(3)	(4)	(3)	(2)
Grand Totals		(6)	(7)	(15)	(8)	(9)	(12)	(13)	(6)

Note: Figures in parenthesis indicate vehicle selection as described in text for report p

Table C-32

27, 723 TRUCKS AND BUSES REGISTERED IN HAMILTON COUNTY, OHIO (CINCINNATI)

$$n_h = \frac{N_h C_h}{\sum_{1}^{504} N_h C_h} 10C \quad \text{where} \quad \sum_{1}^{504} N_h C_h = 7,855,160$$

7	YEAR MODELS 1956	1955	1954	1953	1952	1951	1950	1949	1948	Totals	Rounded Totals
54	(1)1.12	(2)1.68	(1)0.95	(1)1.02	(1)0.60	(1)0.78	(1)0.82	(1)0.61	(1)0.69	15.89	16
78	(1)0.50	(1)0.95	0.47	(1)0.45	0.35	0.32	0.41	0.17	0.20	7.33	7
										0.24	1
										23.46	24
							0.01	0.01	0.00+	0.02	0
	0.00+	0.01	0.00+	0.02		0.02	0.01	0.04	0.01	0.11	0
05	(1)0.11	0.04	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.44	1
										0.57	1
02	0.03	0.03	0.02	0.04	0.02	0.04	0.06	0.03	0.04	0.38	0
01	0.06	0.05	0.01	0.01	0.01	0.06	0.01	0.02	0.04	0.36	0
											0
										0.74	0
40	0.39	(1)0.39	0.28	0.32	(1)0.36	0.24	0.26	0.27	0.34	3.85	3
11	0.11	0.08	0.11	(1)0.22	0.14	0.15	0.18	0.16	0.19	1.57	2
02	0.02	0.00+			0.01		0.00+	0.01	0.01	0.27	1
										5.69	6
34	(2)1.88	(2)1.55	(1)1.19	(1)1.34	(1)0.83	(1)1.03	(1)1.09	0.48	(1)0.54	16.69	16
57	(1)0.93	(1)0.77	(1)0.52	0.47	(1)0.51	(1)0.73	(1)0.61	0.34	0.39	7.83	8
09	0.20	0.14	0.10	0.17	0.19	0.15	0.11	0.05	0.06	3.06	3
										27.58	27
13	(1)0.26	0.16	0.09	0.17	0.21	0.11	0.13	0.09	0.17	2.32	2
20	(1)0.31	(1)0.39	0.19	0.20	0.23	0.16	0.25	0.12	0.22	3.23	3
24	(1)0.47	(1)0.32	0.21	(1)0.38	0.11	0.22	0.26	0.03	0.06	3.29	4
										8.84	9
33	(1)0.38	(1)0.49	0.32	0.29	(1)0.36	0.32	0.21	0.23	0.23	4.57	4
22	0.37	(1)0.59	(1)0.46	(1)0.48	0.37	0.42	0.37	0.23	0.23	5.28	5
05	(1)0.74	0.41	0.23	0.30	(1)0.39	0.21	0.26	0.13	0.13	6.77	7
										16.62	16
											0
				0.01		0.02		0.00+	0.00+	0.03	0
97	(1)0.67	(1)0.60	(1)0.31	0.21	0.17	0.34	0.23	0.09	0.06	5.32	6
										5.35	6
03	0.03	0.09	0.01	0.09	0.07	0.08	0.07	(1)0.13	0.03	0.77	1
01	0.00+	0.01	0.01	0.03	0.02	0.04	0.04	0.07	0.02	0.27	0
											0
										1.04	1
										0.02	0
00+	0.01	0.02	0.04	0.06	0.04	(1)0.06	0.03	0.06	0.05	0.37	1
60	0.34	(1)0.74	(1)0.71	0.47	0.44	(1)0.47	0.38	0.27	0.30	6.48	6
										6.87	7
03	0.03	0.01	0.01	0.01	0.01	0.05	0.03	0.02	0.05	0.45	0
											0
											0
										0.45	0
04	0.01	0.00+			0.03	0.02	0.03	0.01	0.02	1.61	2
	0.00+	0.01	0.02	0.03	0.01	0.02	0.03	0.01	0.03	0.16	0
03	0.02	0.01	0.01	0.05	0.04	0.03	0.07	0.01	0.03	0.52	1
										2.29	3
	(5)	(6)	(2)	(2)	(4)	(2)	(2)	(2)	(2)	46.57	44
	(3)	(4)	(2)	(3)	(1)	(2)	(1)	(0)	(0)	26.54	26
	(4)	(3)	(2)	(1)	(1)	(1)	(0)	(0)	(0)	26.39	30
	(12)	(13)	(6)	(6)	(6)	(5)	(3)	(2)	(2)	99.50	100

described in text for report period ending December 1, 1961.

Table C-33

SELECTION OF 100 VEHICLES FROM A TOTAL OF 21,535 TRUCKS AND BUSES REGISTE

Values for $n_h = \frac{N_h C_h}{\sum_{1}^{504} N_h C_h}$ 100 where $\sum_{1}^{504} N_h C_h = 5,6$

Vehicle Make	Weight Class	YEAR MODELS								
		1961	1960	1959	1958	1957	1956	1955	1954	1953
Chevrolet	Light	(1)1.32	(1)1.11	(1)0.87	(2)2.02	(3)2.61	(2)1.85	(3)2.74	(2)2.04	(2)2.1
	Medium	(1)0.50	0.28	(1)0.64	(1)0.50	(1)0.81	0.43	(1)0.82	0.48	(1)0.5
	Heavy	0.13	(1)0.13							
Diamond T	Light									
	Medium			0.01	0.08		0.03	0.05	0.06	0.1
	Heavy	0.08	0.03	0.08	(1)0.15	0.11	0.10	0.09	0.05	0.0
Divco		None Registered								
Dodge-Plymouth	Light	0.09	0.07	0.13	0.12	0.29	0.22	(1)0.44	0.20	(1)0.5
	Medium	0.05	0.00+	(1)0.50	0.11	0.07	0.07	0.10	0.08	(1)0.2
	Heavy	0.01	0.01	0.02			0.01		0.01	0.0
Ford	Light	(1)1.19	(1)0.97	(2)1.73	(1)1.36	(2)1.68	(2)2.38	(2)1.73	(1)1.42	(1)1.4
	Medium	0.46	0.44	(1)0.49	(1)0.61	(1)0.68	(1)1.20	(1)0.74	(1)0.79	(1)0.6
	Heavy	0.17	0.13	(1)0.21	(1)0.40	0.05	0.07	0.12	0.03	0.0
G. M. C.	Light	0.20	0.15	(1)0.38	0.20	0.15	0.26	0.19	0.17	0.2
	Medium	0.22	0.14	(1)0.37	0.15	0.17	(1)0.36	0.19	0.26	(1)0.2
	Heavy	(1)0.16	0.15	(1)0.17	0.06	0.05	0.09	0.09	0.07	0.1
International	Light	0.45	0.32	(1)0.68	(1)0.78	(1)0.52	(1)0.87	(1)0.66	(1)0.56	0.3
	Medium	0.44	0.32	(1)0.60	(1)0.91	(1)0.60	(1)0.56	0.45	(1)0.53	(1)0.5
	Heavy	(1)0.48	0.41	(1)0.57	(1)0.55	(1)0.58	0.21	0.23	0.14	0.1
Mack	Light									
	Medium					0.01				
	Heavy	0.08	0.05	0.21	0.15	0.21	(1)0.42	(1)0.25	0.08	0.1
Studebaker	Light	0.02	0.02	0.02	0.02	0.03	0.04	0.04	0.04	(1)0.1
	Medium						0.00+	0.00+	0.01	0.0
	Heavy									
White	Light									
	Medium					0.01	0.02	0.05	0.02	0.0
	Heavy	0.13	0.11	(1)0.38	0.29	0.23	0.18	(1)0.37	0.21	0.2
Willys	Light	0.03	0.03	0.03	0.02	0.01	0.01	0.00+	0.00+	0.01
	Medium									
	Heavy									
Miscellaneous	Light	(1)0.41	0.36	(1)0.78	0.30	0.06	0.04	0.03		
	Medium					0.01		0.01	0.03	0.01
	Heavy	0.01	0.02	0.03				0.02	0.01	0.03
Totals	Light	(3)	(2)	(6)	(4)	(6)	(5)	(7)	(4)	(5)
	Medium	(1)	(0)	(5)	(3)	(3)	(3)	(2)	(2)	(5)
	Heavy	(2)	(1)	(4)	(3)	(1)	(1)	(2)	(0)	(0)
Grand Totals		(6)	(3)	(15)	(10)	(10)	(9)	(11)	(6)	(10)

Note: Figures in parenthesis indicate vehicle selection as described in text for report period ending

Table C-33

TAL OF 21,535 TRUCKS AND BUSES REGISTERED IN ORLEANS COUNTY (NEW ORLEANS)

s for $n_h = \frac{N_h C_h}{\sum_{1}^{504} N_h C_h}$ 100 where $\sum_{1}^{504} N_h C_h = 5,636,271$

YEAR MODELS											
1957	1956	1955	1954	1953	1952	1951	1950	1949	1948	Totals	Rounded Totals
(3)2.61	(2)1.85	(3)2.74	(2)2.04	(2)2.15	(1)1.43	(1)1.50	(1)1.39	(1)0.95	(1)0.67	22.65	22
(1)0.81	0.43	(1)0.82	0.48	(1)0.51	0.40	0.43	0.36	0.21	0.15	6.00	6
										0.26	1
										28.91	29
							0.02	0.06	0.07	0.15	0
	0.03	0.05	0.06	0.10	0.07	(1)0.21	0.17	0.06	0.07	0.91	1
0.11	0.10	0.09	0.05	0.04	0.14	0.04	0.05	0.05	0.07	1.08	1
										2.14	2
0.29	0.22	(1)0.44	0.20	(1)0.52	(1)0.47	0.27	(1)0.59	0.34	0.35	4.10	4
0.07	0.07	0.10	0.08	(1)0.22	0.17	0.07	0.15	0.12	0.12	1.83	2
	0.01		0.01	0.03	0.01	0.01				0.11	0
										6.04	6
(2)1.68	(2)2.38	(2)1.73	(1)1.42	(1)1.43	(1)0.74	(1)0.87	(1)1.03	(1)0.80	0.56	17.89	17
(1)0.68	(1)1.20	(1)0.74	(1)0.79	(1)0.69	0.44	(1)0.47	0.39	0.23	0.16	7.79	8
0.05	0.07	0.12	0.03	0.06	0.02	0.02	0.03	0.01	0.01	1.33	2
										27.01	27
0.15	0.26	0.19	0.17	0.27	(1)0.33	0.34	(1)0.45	0.33	0.37	3.79	3
0.17	(1)0.36	0.19	0.26	(1)0.25	0.18	0.16	0.21	0.17	0.12	2.95	3
0.05	0.09	0.09	0.07	0.16	0.07	0.08	0.04	0.06	0.06	1.31	2
										8.05	8
(1)0.52	(1)0.87	(1)0.66	(1)0.56	0.38	(1)0.50	0.48	0.48	0.33	0.34	7.35	7
(1)0.60	(1)0.56	0.45	(1)0.53	(1)0.50	(1)0.67	0.45	0.47	0.35	0.36	7.21	7
(1)0.58	0.21	0.23	0.14	0.11	0.13	0.10	0.10	0.10	0.11	3.82	4
										18.38	18
											0
0.01					0.01	0.01	0.02	0.06	0.05	0.16	0
0.21	(1)0.42	(1)0.25	0.08	0.16	0.17	0.05	0.09	0.04	0.05	2.01	2
										2.17	2
0.03	0.04	0.04	0.04	(1)0.15	0.11	0.11	0.08	0.13	0.02	0.82	1
	0.00+	0.00+	0.01	0.08	0.06	0.04	0.03	0.07	0.01	0.32	0
											0
										1.14	1
											0
0.01	0.02	0.05	0.02	0.09	(1)0.17	0.01	0.05	0.05	0.04	0.51	1
0.23	0.18	(1)0.37	0.21	0.20	(1)0.25	0.24	0.18	0.15	0.14	3.06	3
										3.57	4
0.01	0.01	0.00+	0.00+	0.01	0.01	0.03	0.04	0.05	0.03	0.30	0
											0
											0
										0.30	0
0.06	0.04	0.03			0.01		0.02	0.03	0.02	2.06	2
0.01		0.01	0.03	0.01	0.03	0.01	0.02	0.02	0.01	0.15	0
		0.02	0.01	0.03	(1)0.05	0.05	0.01	0.01	0.01	0.25	1
										2.46	3
)	(5)	(7)	(4)	(5)	(5)	(2)	(4)	(2)	(1)	59.11	56
)	(3)	(2)	(2)	(5)	(2)	(2)	(0)	(0)	(0)	27.83	28
)	(1)	(2)	(0)	(0)	(2)	(0)	(0)	(0)	(0)	13.23	16
)	(9)	(11)	(6)	(10)	(9)	(4)	(4)	(2)	(1)	100.17	100

n as described in text for report period ending December 1, 1961.

Table C-34

SELECTION OF 100 VEHICLES FROM A TOTAL OF 50,413 TRUCKS AND BUSES REGISTERED I

Values for $n_h = \frac{N_h C_h}{\sum_{1}^{504} N_h C_h}$ 100 where $\sum_{1}^{504} N_h C_h = 14,602.$

Vehicle Make	Weight Class	YEAR MODELS								
		1961	1960	1959	1958	1957	1956	1955	1954	1953
Chevrolet	Light	(1)0.93	(1)0.86	(1)1.22	(1)1.30	(1)1.35	(1)1.39	(2)1.68	(1)1.22	(1)1.03
	Medium	0.22	0.19	(1)0.29	0.26	(1)0.34	0.25	(1)0.37	0.26	(1)0.24
	Heavy	0.02	0.02							
Diamond T	Light									
	Medium						0.01	0.01	0.01	0.00+
	Heavy	0.03	0.02	0.01	(1)0.03	0.02	0.05	0.01	0.00+	0.01
Divco	Light	0.09	0.08	0.04	0.04	0.03	0.05	0.05	0.09	0.04
	Medium	0.01	0.00	0.01	0.01	0.00	0.01	0.00+	0.01	0.01
	Heavy									
Dodge-Plymouth	Light	0.26	0.25	0.27	0.29	(1)0.40	(1)0.42	0.32	(1)0.49	0.31
	Medium	0.11	0.11	0.21	0.14	0.22	(1)0.25	0.26	(1)0.41	(1)0.30
	Heavy	0.05	0.05	0.04	(1)0.09	0.06	0.03	0.06	0.05	0.02
Ford	Light	(1)0.69	(1)0.68	(1)1.08	(1)0.74	(1)0.94	(2)2.02	(1)1.48	(1)0.89	(1)1.30
	Medium	0.35	0.37	(1)0.40	0.21	0.30	(1)0.80	0.47	0.44	(1)0.60
	Heavy	(1)0.18	0.17	0.23	0.09	0.05	(1)0.19	0.10	0.09	0.14
G. M. C.	Light	0.27	0.21	0.29	(1)0.43	0.36	(1)0.31	0.29	(1)0.36	0.21
	Medium	0.29	(1)0.31	0.29	(1)0.27	0.31	(1)0.36	(1)0.59	0.30	0.21
	Heavy	0.24	0.25	0.25	(1)0.33	(1)0.41	(1)0.32	0.20	0.19	0.09
International	Light	0.40	0.40	0.39	(1)0.57	0.38	(1)0.58	(1)0.51	(1)0.55	0.31
	Medium	(1)0.57	(1)0.57	0.47	(1)0.89	(1)0.49	0.45	(1)0.57	(1)0.84	0.27
	Heavy	(1)0.71	(1)0.72	(1)0.75	(1)0.61	(1)0.61	0.44	0.22	0.29	0.10
Mack	Light									
	Medium					0.02	0.01	0.02	0.05	0.01
	Heavy	(1)0.88	(1)0.81	(1)0.82	(1)0.79	(1)0.95	(1)0.74	(1)0.82	(1)0.49	0.21
Studebaker	Light	0.03	0.03	0.02	0.02	0.00+	0.02	0.02	0.03	0.02
	Medium					0.01	0.00+	0.01	0.03	0.02
	Heavy									
White	Light	0.00+	0.00+							
	Medium					0.02	0.04	0.04	(1)0.19	0.08
	Heavy	(1)0.75	(1)0.69	(1)0.87	(1)0.67	(1)1.09	(1)0.72	(1)0.61	(1)0.96	0.35
Willys	Light	0.06	(1)0.07	0.06	0.06	0.03	0.01	0.01	0.02	0.02
	Medium									
	Heavy									
Miscellaneous	Light	0.16	0.13	(1)0.59	(1)0.44	0.18	0.07	0.01	0.00+	0.00+
	Medium					0.01	0.02	0.04	0.04	0.02
	Heavy	0.03	0.03	0.07	0.04	0.07	0.13	0.23	(1)0.38	(1)0.38
Totals	Light	(2)	(3)	(3)	(5)	(3)	(6)	(4)	(5)	(2)
	Medium	(1)	(2)	(2)	(2)	(2)	(3)	(3)	(3)	(3)
	Heavy	(4)	(3)	(3)	(6)	(4)	(4)	(2)	(3)	(1)
Grand Totals		(7)	(8)	(8)	(13)	(9)	(13)	(9)	(11)	(6)

Note: Figures in parenthesis indicate vehicle selection as described in text for report period ending D

Table C-34

TRUCKS AND BUSES REGISTERED IN PHILADELPHIA COUNTY (PHILADELPHIA)

$\frac{N_h C_h}{\sum_1^{504} N_h C_h}$ 100 where $\sum_1^{504} N_h C_h = 14,602,434$

YEAR MODELS										Rounded
1956	1955	1954	1953	1952	1951	1950	1949	1948	Totals	Totals
(1)1.39	(2)1.68	(1)1.22	(1)1.03	(1)0.75	(1)1.03	(1)0.93	(1)0.66	(1)0.59	14.94	15
0.25	(1)0.37	0.26	(1)0.24	0.21	0.20	0.27	0.14	0.13	3.37	4
									0.04	0
									18.38	20
						0.00+	0.00+	0.01	0.01	0
0.01	0.01	0.01	0.00+	0.01	0.03	0.01	0.02	0.02	0.12	0
0.05	0.01	0.00+	0.01	0.01	0.01	0.01	0.00	0.01	0.22	1
									0.35	1
0.05	0.05	0.09	0.04	0.09	0.13	(1)0.14	0.05	0.13	1.05	1
0.01	0.00+	0.01	0.01	0.03	0.02	0.00+			0.11	0
										0
									1.16	1
(1)0.42	0.32	(1)0.49	0.31	(1)0.41	(1)0.44	0.33	0.32	0.29	4.80	5
(1)0.25	0.26	(1)0.41	(1)0.30	0.25	0.29	0.19	0.20	0.19	3.13	3
0.03	0.06	0.05	0.02	0.02	0.08	0.01	0.01	0.01	0.58	1
									8.51	9
(2)2.02	(1)1.48	(1)0.89	(1)1.30	(1)0.79	(1)0.85	(1)1.31	0.43	0.64	13.84	13
(1)0.80	0.47	0.44	(1)0.60	(1)0.57	(1)0.57	(1)0.70	0.29	0.42	6.49	6
(1)0.19	0.10	0.09	0.14	0.15	0.11	0.08	0.02	0.02	1.62	2
									21.95	21
(1)0.31	0.29	(1)0.36	0.21	0.21	0.26	0.27	0.22	0.21	3.90	3
(1)0.36	(1)0.59	0.30	0.21	0.22	0.26	0.16	0.13	0.13	3.83	4
(1)0.32	0.20	0.19	0.09	0.09	0.16	0.04	0.08	0.07	2.72	3
									10.45	10
(1)0.58	(1)0.51	(1)0.55	0.31	(1)0.43	0.29	0.28	0.19	0.20	5.48	5
0.45	(1)0.57	(1)0.84	0.27	0.34	(1)0.39	0.30	0.17	0.17	6.49	7
0.44	0.22	0.29	0.10	0.10	0.12	0.06	0.05	0.05	4.83	5
									16.80	17
										0
0.01	0.02	0.05	0.01	0.00+	0.05	0.04	0.06	0.07	0.33	0
(1)0.74	(1)0.82	(1)0.49	0.21	0.23	0.35	0.24	0.14	0.22	7.69	8
									8.02	8
0.02	0.02	0.03	0.02	0.03	0.02	0.02	0.03	0.02	0.31	0
0.00+	0.01	0.03	0.02	0.02	0.02	0.02	0.03	0.03	0.19	0
										0
									0.50	0
										0
0.04	0.04	(1)0.19	0.08	0.07	0.07	0.09	0.04	0.05	0.69	1
(1)0.72	(1)0.61	(1)0.96	0.35	0.33	0.55	0.33	0.21	0.24	8.37	8
									9.06	9
0.01	0.01	0.02	0.02	0.03	0.02	0.03	0.02	0.04	0.48	1
										0
										0
									0.48	1
0.07	0.01	0.00+	0.00+	0.01	0.01	0.01	0.01	0.02	1.64	2
0.02	0.04	0.04	0.02	0.03	0.04	0.02	0.02	0.05	0.29	0
0.13	0.23	(1)0.38	(1)0.38	0.26	0.25	0.18	0.06	0.14	2.25	2
									4.18	4
)	(4)	(5)	(2)	(4)	(3)	(3)	(1)	(1)	46.45	45
)	(3)	(3)	(3)	(1)	(2)	(1)	(0)	(0)	25.04	25
)	(2)	(3)	(1)	(0)	(0)	(0)	(0)	(0)	28.32	30
)	(9)	(11)	(6)	(5)	(5)	(4)	(1)	(1)	99.81	100

ibed in text for report period ending December 1, 1961.

Table C-35

SELECTION OF 100 VEHICLES FROM A TOTAL OF 22,277 TRUCKS AND BUSES REG

Values for $n_h = \frac{N_h C_h}{\sum_{1}^{504} N_h C_h}$ 100 where $\sum_{1}^{504} N_h C_h = 6,030,7$

Vehicle Make	Weight Class	YEAR MODELS								
		1961	1960	1959	1958	1957	1956	1955	1954	1953
Chevrolet	Light	(2)1.64	(2)1.52	(2)2.38	(2)2.02	(2)2.15	(1)1.51	(2)2.32	(1)1.26	(1)1.39
	Medium	0.43	(1)0.39	(1)0.71	0.44	(1)0.57	(1)0.53	(1)0.65	0.36	(1)0.40
	Heavy	0.05	0.05							
Diamond T	Light									
	Medium									
	Heavy	0.05	(1)0.07	0.04	0.05	0.01			0.01	0.01
Divco	Light	(1)0.18	0.16	(1)0.14	0.05	0.09	0.16	0.07	0.07	0.06
	Medium	0.02	0.03	0.02	0.03	0.01	0.01	0.03	0.04	0.04
	Heavy									
Dodge-Plymouth	Light	0.18	0.22	(1)0.36	0.33	0.29	(1)0.34	0.33	0.19	0.36
	Medium	0.02	0.05	0.07	0.13	0.05	(1)0.16	0.14	0.14	0.25
	Heavy	0.01	0.01	(1)0.04	0.03	0.01	0.01			
Ford	Light	(1)1.10	(1)0.99	(2)1.82	(1)1.48	(1)1.59	(2)2.31	(1)1.56	(1)0.88	(1)0.97
	Medium	0.47	0.45	(1)0.93	(1)0.60	(1)0.57	(1)0.90	(1)0.62	(1)0.58	0.43
	Heavy	0.25	0.21	(1)0.48	(1)0.40	0.13	(1)0.21	0.12	0.04	0.07
G. M. C.	Light	0.19	0.16	0.28	(1)0.32	(1)0.40	0.36	0.26	0.13	0.27
	Medium	0.30	0.27	(1)0.74	0.43	(1)0.45	(1)0.65	(1)0.80	0.31	(1)0.40
	Heavy	0.18	0.13	(1)0.46	0.26	0.21	(1)0.35	0.32	0.07	0.18
International	Light	0.27	0.26	(1)0.42	(1)0.44	0.26	0.38	(1)0.44	0.36	0.41
	Medium	0.19	0.17	0.29	(1)0.39	0.23	(1)0.34	(1)0.45	0.33	0.31
	Heavy	(1)0.23	0.19	(1)0.83	(1)0.57	(1)0.54	(1)0.67	0.27	0.04	0.09
Mack	Light									
	Medium							0.01	0.01	
	Heavy	(1)0.76	(1)0.75	0.46	(1)0.49	(1)0.53	(1)0.51	0.15	0.12	0.18
Studebaker	Light	0.02	0.02	0.01		0.01	0.03	0.03	0.01	0.02
	Medium					0.00+			0.01	0.02
	Heavy									
White	Light	0.00+	0.01							
	Medium					0.01	0.05	(1)0.20	0.11	
	Heavy	0.16	0.14	(1)0.28	0.15	(1)0.41	(1)0.43	0.29	0.28	0.26
Willys	Light	0.06	0.07	0.06	0.07	0.05	0.06	0.02	0.01	0.02
	Medium									
	Heavy									
Miscellaneous	Light	(1)0.48	0.46	(1)0.96	0.44	0.10	0.03			0.00+
	Medium					0.02	0.02	0.03	0.01	0.01
	Heavy	0.01	0.01	0.03	0.01	0.01	0.03	(1)0.07	0.01	0.06
Totals	Light	(5)	(3)	(8)	(5)	(4)	(4)	(4)	(2)	(2)
	Medium	(0)	(1)	(3)	(2)	(3)	(5)	(5)	(1)	(2)
	Heavy	(2)	(2)	(5)	(3)	(3)	(5)	(1)	(0)	(0)
Grand Totals		(7)	(6)	(16)	(10)	(10)	(14)	(10)	(3)	(4)

Note: Figures in parenthesis indicate vehicle selection as described in text for report period ending Dec

Table C-35

OM A TOTAL OF 22,277 TRUCKS AND BUSES REGISTERED IN WASHINGTON, D.C.

es for $n_h = \frac{N_h C_h}{\sum_{1}^{504} N_h C_h}$ 100 where $\sum_{1}^{504} N_h C_h = 6,030,714$

YEAR MODELS											
1957	1956	1955	1954	1953	1952	1951	1950	1949	1948	Totals	Rounded Totals
(2)2.15	(1)1.51	(2)2.32	(1)1.26	(1)1.39	(1)1.00	(1)1.43	(1)1.24	(1)0.80	(1)0.62	21.28	20
(1)0.57	(1)0.53	(1)0.65	0.36	(1)0.40	0.39	(1)0.46	0.26	0.16	0.12	5.87	7
										0.10	0
										27.25	27
							0.01			0.01	0
						0.01	0.04	0.01	0.03	0.09	0
0.01			0.01	0.01	0.01	0.01	0.03	0.01	0.01	0.31	1
										0.41	1
0.09	0.16	0.07	0.07	0.06	0.07	0.10	0.15	0.12	0.16	1.58	2
0.01	0.01	0.03	0.04	0.04	0.04		0.01	0.01	0.01	0.30	0
											0
										1.88	2
0.29	(1)0.34	0.33	0.19	0.36	(1)0.62	0.31	(1)0.36	0.27	0.26	4.42	4
0.05	(1)0.16	0.14	0.14	0.25	(1)0.40	0.21	0.15	0.15	0.14	2.06	2
0.01	0.01				0.01		0.01	0.00+	0.01	0.14	1
										6.62	7
(1)1.59	(2)2.31	(1)1.56	(1)0.88	(1)0.97	(1)0.67	(1)0.87	(1)0.80	(1)0.57	(1)0.61	16.22	16
(1)0.57	(1)0.90	(1)0.62	(1)0.58	0.43	(1)0.62	(1)0.62	0.49	0.35	0.38	8.01	8
0.13	(1)0.21	0.12	0.04	0.07	0.07	0.18	0.06	0.05	0.05	2.32	3
										26.55	27
(1)0.40	0.36	0.26	0.13	0.27	0.29	(1)0.32	0.28	0.19	0.18	3.63	3
(1)0.45	(1)0.65	(1)0.80	0.31	(1)0.40	0.40	(1)0.59	0.36	0.15	0.13	5.98	6
0.21	(1)0.35	0.32	0.07	0.18	0.12	(1)0.18	0.18	0.03	0.03	2.70	3
										12.31	12
0.26	0.38	(1)0.44	0.36	0.41	0.39	(1)0.53	0.35	0.14	0.22	4.87	4
0.23	(1)0.34	(1)0.45	0.33	0.31	0.26	0.28	0.23	0.13	0.20	3.80	3
(1)0.54	(1)0.67	0.27	0.04	0.09	0.04	0.13	0.10	0.04	0.06	3.80	5
										12.47	12
											0
		0.01	0.01			0.03	0.01	0.01	0.02	0.09	0
(1)0.53	(1)0.51	0.15	0.12	0.18	0.17	0.11	0.16	0.09	0.20	4.68	5
										4.77	5
0.01	0.03	0.03	0.01	0.02	0.04	0.04	0.02	0.03	0.01	0.29	0
0.00+			0.01	0.02	0.02	0.03	0.03	0.03	0.01	0.15	0
											0
										0.44	0
										0.01	0
0.01	0.05	(1)0.20	0.11		0.02	0.07	0.03	0.04	0.07	0.60	1
(1)0.41	(1)0.43	0.29	0.28	0.26	0.24	0.16	0.07	0.07	0.11	3.64	3
										4.25	4
0.05	0.06	0.02	0.01	0.02	0.02	0.05	0.05	0.02	0.03	0.59	0
											0
											0
										0.59	0
0.10	0.03			0.00+	0.00+	0.01	0.00+	0.01	0.00+	2.49	2
0.02	0.02	0.03	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.16	0
0.01	0.03	(1)0.07	0.01	0.06	0.04	0.04	0.02	0.05	0.02	0.41	1
										3.06	3
(4)	(4)	(4)	(2)	(2)	(3)	(4)	(3)	(2)	(2)	55.39	51
(3)	(5)	(5)	(1)	(2)	(2)	(3)	(0)	(0)	(0)	27.11	27
(3)	(5)	(1)	(0)	(0)	(0)	(1)	(0)	(0)	(0)	18.10	22
(10)	(14)	(10)	(3)	(4)	(5)	(8)	(3)	(2)	(2)	100.60	100

tion as described in text for report period ending December 1, 1961.

SECTION D

VEHICLE PROCUREMENT

An attempt has been made to locate truck and bus operators willing to cooperate with us on this survey. One approach was through contacts made with the American Trucking Association. Thus far, members of the regional branches in Los Angeles, San Francisco, and Detroit have been solicited by a questionnaire (see previous Progress Report) submitted by these branches. The returns from these questionnaires show that approximately 4% of the members solicited are willing to cooperate. This amounts to about 50 truck operators in each city. The size of the fleets involved range from 1 to 70 trucks. This indicates that both large and small fleet operators are located by working through these trucking associations. Since we do not expect to use very many of the trucks in any one fleet, we undoubtedly will have to locate other fleet operators as well. We believe this can be accomplished through our local representatives in each city. It is felt, however, that the early contacts obtained through the auspices of the American Trucking Association will enable us to start the survey in each city with a minimum of delay and lost time.

SECTION E

TABLE OF CONTENTS

SHAKEDOWN TESTS E-1

DETROIT SURVEY DATA E-1

AUXILIARY EQUIPMENT E-2

SECTION E

DATA PROCUREMENT

SHAKEDOWN TESTS

Procurement of punched-tape data, showing manifold vacuum and engine speed at one second intervals, was started on January 30, 1962, on commercial vehicles operating in the Detroit area. The purpose in these initial tests was to uncover any malfunctioning of the recording equipment, as well as to obtain survey data for the trucks and buses in the Detroit area. These early tests have also been useful in instructing the test personnel on ways to handle problems which might arise in installing the equipment in vehicles of different types.

Problems discovered when the equipment was installed in commercial vehicles were:

1. Relatively high generator voltage. This caused the punch-tape recorder to malfunction. The method of handling this problem is detailed in Section A, Vehicle Instrumentation.

2. Improper tracking of the paper tape on the take-up reel. This occurred when the equipment was used in a heavy truck operated over a rough road. The equipment received heavy jarring and caused the tape to jump out of the guide which directed it onto the take-up spool. This problem was cured by using an improved guide.

3. Excessive bouncing of recording equipment when installed in some vehicles. This problem was handled by improving the installation and using foam-rubber cushions under each unit.

4. Wrong parity punching after some extended use of the equipment. The method of handling this problem is described in Section A, Vehicle Instrumentation.

DETROIT SURVEY DATA

Thus far, only one punch-tape recorder is in service. This unit has been used to obtain satisfactory tapes on five trucks in Detroit. Each of these vehicles was in operation for a period of approximately seven hours, during which data in any one-second interval was incorrectly

recorded only about 0.1% of the time. Around one-third of this incorrect information was obtained when the ignition key was turned off, then on. It is believed this performance of the instrument is satisfactory for its intended use. Figures 9 and 10 are photographs of the equipment installed in a truck.

This section contains an example of the snap-out data sheet which will be used to record all pertinent information relating to each tape record. One copy will be mailed to the computer center with each tape. The other copy will be retained by the field-test personnel.

AUXILIARY EQUIPMENT

A 1960 Ford Fairlane station wagon has been fitted for transporting the test personnel and equipment, as well as for testing the instruments before installation in trucks and buses. The back of the station wagon is fitted with racks and tie-down straps for safely carrying five punch-tape recorders and the five corresponding electronic programmers and encoders. A photograph of this part of the car is shown in Figure 12. To further guard the equipment in the vehicle, all doors, the engine hood, and the tailgate have been equipped with electrical switches which will activate a siren in the event that these parts of the vehicle are tampered with after a lock switch has been set.

Figure 11 is a photograph of the engine-speed and manifold-vacuum test equipment located on the dash ahead of the right front seat. The installation allows one of the paper-tape recorders to be connected to the vehicle ignition and manifold vacuum at the same time as the test equipment. A comparison between the two instruments can be quickly made to determine whether or not the tape recorder is operating properly.

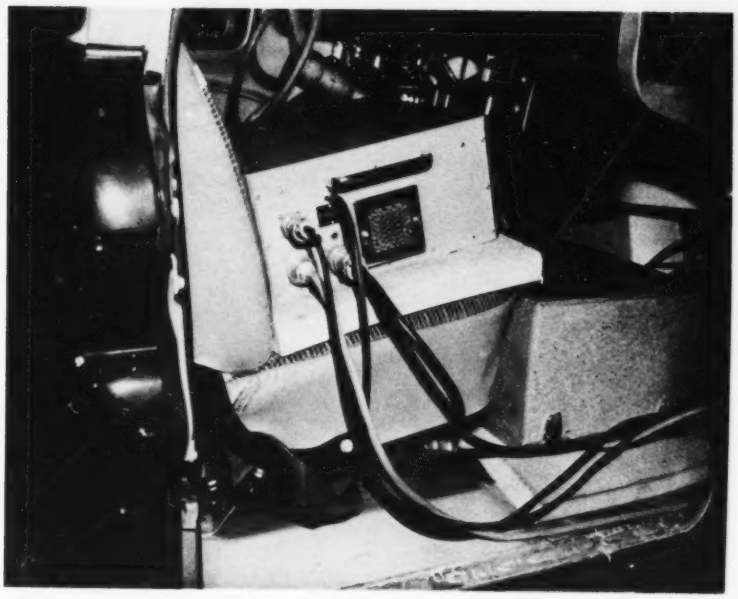


Figure 9

Electronic Programmer on Seat
And Punch Tape on Floor of Truck

Figure 10

Punch-Tape Instrument in Service in Truck

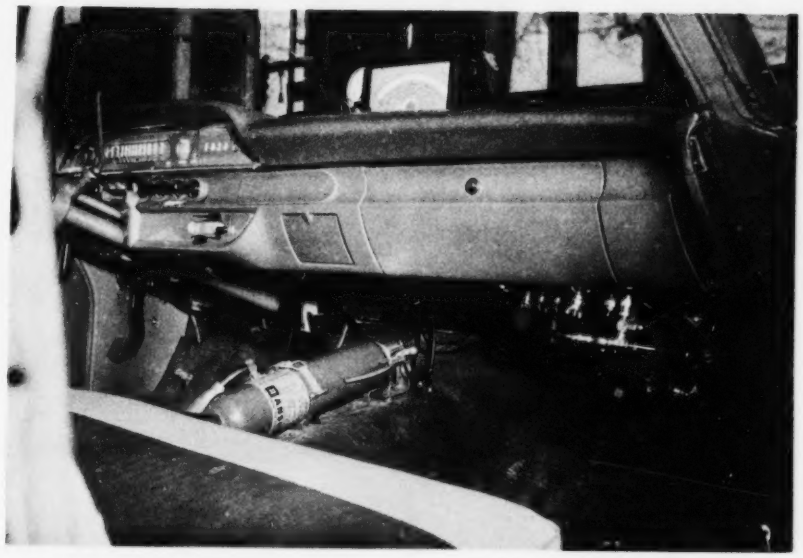


Figure 11

Equipment in Station Wagon
for Checking Punch-Tape Instruments

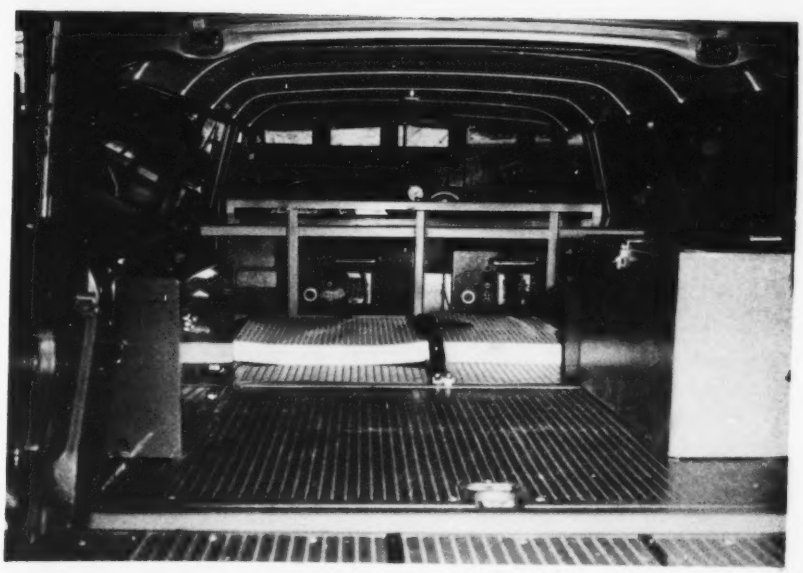


Figure 12

Rear of Station Wagon for Transporting Punch-Tape Instruments

U. S. PUBLIC HEALTH SURVEY OF OPERATING MODES OF TRUCKS AND BUSES

City _____ Date of Report _____

Punch-Tape No. _____ (Write same no. on tape record)

1. Vehicle Source

Company _____ No. of Vehicles in Fleet _____

Address _____

Type of Service _____ Maintenance Schedule _____

Avg. Miles Operation/Day/Veh. _____

2. Test Vehicle Information (Gasoline ☐ Diesel ☐)

Vehicle Make _____ Model _____ Year _____

Engine Make _____ Model _____ Year _____

Gross Weight (GVW), lbs. _____ Loaded Weight, lbs. _____

Specific Type of Service _____ License _____

Engine Displacement _____ Transmission _____

3. Test Information

Odometer, Start _____ End _____

Hot Idle Vacuum, Start _____ End _____

Date and Time, Start _____ End _____

Fuel Consumed in Trip _____ Atmos. Temp., ^{o}F _____

Road Condition During Test (wet, snow, etc.) _____

Unusual Driving Circumstances (detours, traffic jams, etc.) _____

Test Duration Counter, Sec. Start _____ End _____

Idle Voltage (Batt.) _____ Generator Voltage _____

4. Personnel

Vehicle Operator _____ Test Operator _____

5. Remarks _____

_____

_____

_____

_____

_____